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1979 AIRCRAFT SYSTEMS/FLIGHT TEST WORKSHOP (1979)

AIRCRAFT ENGINEERING DIVISION

SYSTEMS AND FLIGHT TEST BRANCHES held

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OCTOBER 2-10, 1979

NASA/AMES RESEARCH CENTER

MOFFETT FIELD, CALIFORNIA

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FEDERAL AVIATION ADMINISTRATION

OFFICE OF AIRWORTHINESS

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16. Abstract

The Systems/Flight Test Workshop report contains those agenda items of mutual interest between regional and headquarters organizations, which were investigated, discussed, and proposed solutions developed. The goal of the Workshop is to develop standardization and a unified position for improved airworthiness standards and certification procedures. Workshop products may include policy and guidance material.

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BACKGROUND

The Systems/Flight Test Workshops have been conducted in the past with the primary objective to pursue every means of insuring regional and headquarters standardization of Airworthiness Standards and Certification Procedures. In addition, pertinent Systems and Flight Test problems of mutual interest are investigated, discussed, and proposed solutions presented to the Workshop participants. The Workshops have established opportunities for free exchange of Regional/Headquarters problems, constructive criticism, and development of recommended solutions. The goal of the Workshop is to develop a unified position, and to propose improved airworthiness standards and certification procedures. The final products may be in the form of policy letters, advisory circulars, orders/notices, or rulemaking actions.

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SUMMARY REPORT

of the

1979 SYSTEMS/FLIGHT TEST WORKSHOP

The 1979 Office of Airworthiness, Aircraft Engineering Division, Systems/Flight Test Workshop was held at the NASA Ames Research Center (ARC), Moffett Field, California, during the period October 2 - 10, 1979.

Systems engineers, Maintenance/Air Carrier, and General Aviation Avionic Inspectors from all regions (except Pacific and European) participated in the discussion of more than 60 agenda items (technical and administrative topics). Designated Engineering Representatives (DER) (more than 60) participated in discussions relative to the DER handbook, DER forum, and the various agenda items of interest.

Systems (AWS-130) and Flight Test (AWS-160) Branches conducted concurrent and combined Workshop sessions during October 2 - 5. Systems and Designated Engineering Representatives met on October 8 - 9 to discuss agenda items.

Technical presentations by General Electric (F-18 Digital Flight Control System), Western Electric (Bubble Memory and Fiber Optics), Logicon (Software Verification/Validation) and Boeing

(Boeing - 757/767 Systems), and a status of the joint FAA/NASA Ames "Simulation Methods for Digital Flight Control Systems" program added appreciably to the Workshop, and the efforts of those responsible are very much appreciated.

The hospitality provided by Ames Research Center is also very much appreciated. The FAA/Ames Research Center, Flight Simulation Branch, AEM-4, handled the administrative details and provided the logistic support in a highly professional manner.

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F/S3	Atmospheric Icing	AWE-160/ACE-216

1979 SYSTEMS/FLIGHT TEST WORKSHOP SCHEDULE

NASA AMES RESEARCH CENTER (ARC), MOFFETT FIELD, CA
OCT. 2-10, 1979

Oct. 1, 1979 (Monday)		o Travel
Oct. 2, 1979 (Tuesday)	0800	o Registration o Welcome - Jack Cayot, FAA/ARC o Introductions o Systems Agenda Items (Ref. INDEX): 1.3 3.4 3.3 3.5 3.1 o Flight Test Agenda Items o Lunch
	1300	o Systems Agenda Items (Ref. INDEX): 3.6 4.1 (20.1) 3.7 6.1 o Flight Test Agenda Items
	1900	o Business Dinner/Social Meeting (Bold Knight Resturant)
Oct. 3, 1979 (Wednesday)	0830	o Systems/Avionic Inspector Agenda Items (Ref. INDEX): 1.2 1.4 3.8 (29.2) 2.1 3.9 3.10 3.11 o Flight Test Agenda Items
	1300	o Systems/Avionic Inspector Agenda Items (Ref. INDEX): 4.2 4.4 (26.1) 4.3 o Flight Test Agenda Items
Oct. 4, 1979 (Thursday)	0830	o Systems/Avionic Inspector Agenda Items (Ref. INDEX): 4.5 (4.1) 6.2 6.5 5.1 6.3 9.2 o Flight Test Agenda Items

Oct. 4 (Continued)

		o Lunch
	1300	o Systems/Avionic Inspector Agenda Item (Ref. INDEX): 10.2 16.1 20.1 10.3 19.1 26.1 (4.4)
		o Flight Test Agenda Items
	1500	o Mr. C. H. Ide, Special Speaker From General Electric: "F-18 Digital Flight Control System"
Oct. 5, 1979 (Friday)	0830	o Flight Test/Systems Combined Meeting (Ref. INDEX): 1.3 4.4 1.4 8.1
		o Mr. R. A. Owens, SAE Staff Consultant, "SAE Committee Actions of Interest"
		o Lunch
	1300	o Flight Test/Systems Combined Meeting (Continued) F/S 1 F/S 3 F/S 2 (20.2)
Oct. 8, 1979 (Monday)	0830	o Systems/Designated Engineering Representatives Agenda Items (Ref. INDEX): 1.1 1.4 3.1 (3.3) 1.2 2.1
		o Lunch
	1300	o Systems/DER Agenda Items (Ref. INDEX) 3.2 3.5 3.7 3.4 3.6 3.4a
	1500	o Special Speakers From Western Electric: Mr. Garner Jones, "Magnetic Bubble Memory" Mr. Richard Punkett, "Fiber Optic Systems"

Oct. 9, 1979 (Tuesday)		o Systems/DER Agenda Items (Ref. INDEX): 1.3 3.8 (29.2) 3.10 5.2 3.9 5.1 5.3
		o Lunch
	1300	o Systems/DER Agenda Items (Ref. INDEX): 4.6 6.4 10.2 17.1 19.1 26.1 6.1 6.5 12.1 17.2 20.2 6.2 8.1 16.1 17.3 20.3 6.3 10.1 16.2 18.1 20.5
Oct. 10, 1979 (Wednesday)	0800	Mr. Jim McWha/Frank Rasmussen, Special Speakers From Boeing: "Boeing 757/767"
		Systems Agenda Items(Ref. INDEX): 6.6 9.3
	1000	o Mr. Cliff Burrous, NASA Ames Research Center: "Status of Simulation Methods for Digital Flight Control Systems" Program
		o Systems Agenda Items (Ref. INDEX): 20.4 29.1 20.7 21.1 20.6
	1500	o Mr. Roger Fujii, Special Speaker From Logicon, Inc.: "Verification & Validation (V & V)"
Oct. 11, 1979 (Thursday)		o Travel

PRESENTATIONS

October 4, 1979 - Mr. C. H. Ide, "F-18 Digital Flight Control System"
General Electric Co., Binghampton, NY

October 5, 1979 - Mr. R. A. (Bob) Owens), SAE Staff Consultant, "SAE
Committee Actions of Interest", SAE., Oklahoma City, OK

October 8, 1979 - Mr. Garner Jones, "Magnetic Bubble Systems"
Mr. Richard Plunkett, "Fiber Optic Systems
Western Electric Co., Greensboro, NC

October 10, 1979 - Messrs. Jim McWha and Frank Rasmussen,"Boeing 757/767"
Boeing Commercial Airplane Co., Seattle, WA

October 10, 1979 - Mr. Cliff Burrous, "Status of Simulation Methods for
Digital Flight Control Systems" Program
NASA Ames Research Center, Moffett Field, CA

October 10, 1979 - Mr. Roger V. Fujii, "Verification and Validation (V & V)"
Logicon, Inc., San Pedro, CA

AGENDA ITEM STATUS

AGENDA ITEMS	RESPONSIBLE ORGANIZATION	ACTION DESCRIPTION	DUE DATE
1.1	AWS-130	Complete AC Systems Design Analysis	12/79
1.2	AWS-130	Investigate STC data sheet feasibility for mandatory maintenance	12/79
	AWS-330	Investigate a training course on mandatory maintenance	12/79
1.3	ASW-216	J. Shapley to provide AWS-130 copy of trip reports on SFAR 29-2	11/79
	All Regions	Requested available installation data from each region	11/79
1.4	AWE-130	Draft AC and coordinate with regions	12/79
	AWE-130	Provide to AWS-130	1/80
2.1	AWS-130	Redraft Part 23.1309 for coordination	3/80
3.1	AWS-130	Mail to System Attendees copy of NPRM 79-15	11/79
	All Regions	Comments due	12/3/79
	AWS-130	Process amendment based on NPRM 79-15	12/79
3.2		No further action	
3.3	AWS-130	Draft copy of Part 37 Subpart A to regions for informal comments	12/79
	All Regions	Comments to AWS-130	1/80
3.4	AFO-512	Handbook Revision	3/80
3.4a	AWS-130	Issue PMA NPRM	1/80
3.5	AWS-130	Publish AC on labeling after TSO PMA adoption	3/80
3.6	All Regions	Provide standardized test procedures to AWE-130	11/1/79
	AWE-130	Provide loose leaf notebook to AWS-130	12/79
3.7	All Regions	Provide standardized test procedures to AWE-130	11/1/79
	AWE-130	Provide loose leaf notebook to AWS-130	12/79

3.8	AWS-343	Coordinate with AEA	3/80
3.9	AWS-330	Coordinate engineering involvement with Avionic Inspectors for BITE certification	6/80
3.10		No further action	
3.11	AWS-330/343	Investigate training course	3/80
	AWS-330	Consider AC for non-TSO'd equipment and incorporate (if appropriate)	3/80
4.1	AWS-330/343	Transmit supplements to all regions	11/79
	All Regions	Review and incorporate (if appropriate) AWE and AEA supplements to 8600.1	1/80
	AWS-330/343	Review supplements for Washington action	3/80
4.2	ASO-213	XMIT K. Blythe Policy Draft Pkg to AFO-510	11/79
	AFO-510	Review and provide index to ANW-213	12/79
	ANW-213	To assemble AFO-510, ASO-213, and AWS-130 input into handbook	1/80
	AWS-130	Publish Handbook	6/80
4.3		No further action	
4.4	AWS-130	Coordinate with AWS-140 policy	11/79
4.5	AWS-130	Coordinate with AGC the interpretation of "major/minor" "approved"	1/80
4.6	All Regions	Review/comment to draft AC Digital Flight Control to AWS-130	11/79
	AWS-130	Finalize Digital AC	1/80
5.1	AWS-130	Publish DER Handbook 8110.37	12/79
5.2	AWS-130	Investigate 8110.4 vs. DER Handbook on inter region DER activity	2/80
5.3		No further action	
6.1		No further action	
6.2	All Regions	Review/comment to draft AC Digital Flight Control (see Agenda Item 4.6)	11/79
	AWS-130	Finalize Digital AC (see Agenda Item 4.6)	1/80
6.3	AWS-130	Draft AC on lightning	1/80
	AWE-ACDO-33	Provide upd. on UAL lightning program	1/80
6.4	AWS-130	Develop/issue policy letter for "Software Program Changes"	12/79

6.5	AWS-343	Investigate the development of avionics cooling AC	6/80
6.5a		No further action	
6.6		No further action	
8.1	AWS-160	Reissue AC 23.1329-1	1/18/80
9.1	AWS-130	Request RTCA to establish Ad Hoc committee to investigate problem	2/80
9.2	AWS-343	Investigate relative to Part 91.10	2/80
9.3	AWS-130	Provide to all regions copy of Aerosonic letter	12/79
10.1	AWS-130	Provide in minute's a copy of regulatory proposal	12/79
	All Regions	Survey & provide input to AWS-130	2/80
10.2	AWS-343	Review 43.13-1A	1/80
	AWS-343	Contact AEA for problem definition	1/80
10.3	AWS-130	Policy letter on batteries other than $LiSO_2$ in minutes	12/79
	AWS-130	Issue alert for disposition of batteries	12/79
12.1	AWS-130	To provide draft AC (from AWS-120) when available	1980
16.1	AWS-330	Issue Order on Ryan Stormscope	12/79
	AWS-130	Issue Order on Equipment in lieu of GPWS	12/79
16.2	AGL-213	Prepare draft AC on Radar Radomes	2/80
17.1	AFO-512	Draft policy guidance-multiple instrument package	1/80
17.2	AFO-512	Prepare NPRM to revise 23.1331 (i.e. 25.1331)	2/80
	AWS-130	Update TSO-C10b(and other similar)	3/80
17.3	AFO-512	Prepare briefing memo	1/80
18.1	ACE-210	Prepare a draft AD	1980
19.1		No further action	
20.1	All Regions	Review/comment to AFO-512 draft AC	1/80

20.2		No further action	
20.3	AFO-512	Ref. AWE-130 letter: Revise AC 120-37 to indicate heading and airspeed inputs & ± 15 NM. Crosstrack	3/80
	AWS-130	Ref. ASW-210 letter: Develop Deselection policy letter	2/80
20.4	AWS-130	Status of Loran-C data (from ARD-300)	12/79
	AWS-330	Obtain Alleghany data	1/80
20.5	AWS-330	See Agenda Item 4.1	3/80
20.6	AWS-343	Review AC 20-62C for current applicability	5/80
20.7	ANW-213	Recommend rulemaking (if appropriate)	1/80
21.1	ANW-213	Recommend rulemaking (if appropriate	2/80
26.1	AWS-130	Coordinate with AWS-140 policy (see Agenda Item 4.4)	1/80
29.1	AGL-213	Provide draft policy letter wire-term	12/79
	AWS-343	Review AC 43.13-1A	12/79
29.2	AWS-343	Update AC 43.13-1A and 2A (see Agenda Item 3.8)	3/80
	AWS-130	Investigate wiring diagrams	3/80
F/S-1		No further action	
F/S-2	AWS-160	Review AFM for referencing manufacturers manual	12/79
	All Regions	Identify Omega approvals to AWS-130	12/79
	AWS-130	Collate and send to all regions	1/80
F/S-3	AFO-512	Study results to AWS-130	12/79
F/S-3	AWE-160 ACE-210 ASO-210	Item a: Provide icing criteria and experience on CAR3/Part 23 to AWS-130/160	1/80
	AWS-130/160	Transmit criteria to all regions	1/80
	AWS-130/160	Item b: To provide policy letter on CAR 3 icing after review of NTSB study	

NOTE: The action for some of the above agenda items is in progress. The results will be forwarded to all attendees when the action is completed.

1.0 REGULATORY/POLICY

AGENDA ITEM 1.1
ENGINEERING/MAINTENANCE
FAR § 25.1309 HANDLING

PROBLEM:

Engineering/Maintenance coordinaton for appropriate guidance material is an open item from two previous workshops (Reference 1977 Agenda Item 14).

STATUS:

Industry groups have not supported the engineering/maintenance concept proposed. FAR § 23-25.1529 maybe utilized for this purpose.

ACTION:

No guidance material in the immediate future is anticipated. However, FAA Order 8620.2 dated November 2, 1978, provides guidance on where and how to list mandatory information.

DISCUSSION: (Ref. Agenda Item 1, 2)

A mandatory maintenance Advisory Circular proposal was strongly opposed by industry and therefore consideration was dropped.

Rulemaking action to insert mandatory maintenance requirements in the Maintenance Manual Rule e.g., 25.1529 have been dropped.

FAA Order 8620.2 has been accepted as guidance as to where and how to list mandatory maintenance information.

Airbus Industrie A300B was the first aircraft utilizing this order.

CONCLUSION:

FAA Order 8620.2 indicates a Type Certificate Data Sheet is an acceptable document for enforcement action, and therefore is being used for mandatory maintenance requirements. AC 25.1309 to be written/published by December 1979.

ORDER **DEPARTMENT OF TRANSPORTATION**
FEDERAL AVIATION ADMINISTRATION

8620.2

11/2/78

SUBJ: APPLICABILITY AND ENFORCEMENT OF MANUFACTURER'S DATA

1. PURPOSE. This order provides information to field personnel concerning the manner in which manufacturer's maintenance manual material, including service letters and service bulletins, could be enforced. This order also discusses conditions for enforcement of the type certificate data sheet or specification.

2. DISTRIBUTION. This order is distributed to Flight Standards in Washington Headquarters, the regions, and the Aeronautical Center to the branch level; to all General Aviation, Air Carrier, Engineering and Manufacturing, and Flight Standards District Offices; and to all International, International Aviation, and Aeronautical Quality Assurance Field Offices.

3. BACKGROUND. There exists a difference of opinion among field inspectors concerning the manner in which manufacturer's maintenance manual material, including service letters and service bulletins, could be enforced by the FAA. FAR 43.13 requires all persons to use methods, techniques, and practices acceptable to the Administrator while performing aircraft maintenance. The manufacturer's maintenance manuals, service bulletins, and service letters have always been regarded as a source of acceptable data for complying with FAR 43.13(a) and (b); however, such acceptability does not, in itself, impose an enforcement or mandatory compliance requirement.

4. ENFORCEMENT. The office of the Chief Counsel has advised that the provisions of the manufacturer's manuals, letters, and bulletins, with relation to specific inspection procedures, may be enforceable by means of an airworthiness directive (AD) or other specific rule. In addition, manufacturer's data contained in a type certificate data sheet or specification may be enforceable under FAR 43.13.

a. An example of an AD is Piper AD 77-23-09, wherein Piper Service Bulletin No. 530 becomes mandatory and enforceable by the following statement contained in the AD: "The manufacturer's specifications and procedures identified and described in this directive are incorporated herein and are made a part hereof pursuant to 5 USC 552(a)(1)." (Ref. Handbook 8040.1A, Airworthiness Directives.)

b. An example of a rule that establishes manufacturer's maintenance inspection criteria as mandatory and enforceable would be FAR 43.15(b), wherein certain inspection criteria for rotorcraft must be performed in accordance with the maintenance manual of the manufacturer concerned. FARs 43.15(c)(2) and 43.16 are other specific examples of regulatory requirements that make manufacturer's procedures mandatory.

Distribution: A-WX (FS)-3; AFS-500 (20 cys);
A-FFS 1, 3, 5, 7, 8 (MAX); A-FIA-O (MAX);
AAC-950 (80 cys); AAC-840 (1 cy)

Initiated By: AFS-830

5. TYPE CERTIFICATE DATA SHEET. The type certificate data sheet or specification contains conditions, limitations, and terms pertinent to the issuance of a particular type certificate. These limitations are issued under authority of Section 603(a)(2) of the FA Act. The data sheets or specifications are themselves a part of the type certificate per FAR 21.41 and may require adherence to manufacturer's maintenance manual material. FAR 43.13, in pertinent part, requires that each person maintaining or altering, or performing preventive maintenance, shall use methods, techniques, and practices acceptable to the Administrator and do that work in such a manner and use materials of such a quality, that the condition of the aircraft, airframe, aircraft engine, propeller, or appliance worked on will be at least equal to its original or properly altered condition. In general, this means that persons performing maintenance are obligated to establish airworthiness by compliance with the conditions and limitations appearing on the type certificate data sheets or specifications. Thus, enforcement of FAR 43.13(a) and/or (b) is quite possible and feasible against maintenance personnel for noncompliance with the data sheets.

6. DATA SHEET NOTES. The language on some data sheets is subject to close evaluation to determine whether or not it is mandatory or informative. A note that typically reads "maintenance information may be found in the xyz manual" is informative and not mandatory. Thus, the notes on data sheets must be carefully read to determine their true impact.

7. EQUIVALENT PROCEDURES. In a hearing on an enforcement action involving a required maintenance procedure prescribed in a type certificate data sheet, the FAA could be faced with a defense that while the data sheet was not strictly adhered to, an equivalent procedure was employed. This possibility must be considered before initiating enforcement action involving a manufacturer's recommended maintenance practice.

8. LIFE LIMITS AND PLACARDING. Nonadherence to life limits or failure to follow placarding instructions specified in type certificate data sheets are typical examples of where sound enforcement action can be taken against maintenance entities, under FAR 43.13(a) and (b).

9. ENFORCEMENT AGAINST THE AIRWORTHINESS CERTIFICATE. While mechanics are subject to FAR 43 and are expected to establish compliance with type certificate data sheets, owners/operators are not expected to be fully knowledgeable of data sheet requirements. Thus, upon discovering nonadherence to the type certificate data sheets, enforcement action should be directed against the airworthiness certificate of the aircraft. Exceeding life limits of parts or not maintaining the aircraft according to a specific required mandate are examples of causes for action against the airworthiness certificate.

10. ENFORCEMENT AGAINST THE OWNER/OPERATOR. It should be noted that certain operators are given notice to comply with type certificate data sheets through FAR 91.217. Failure of an owner/operator to comply after being duly notified, in the regulations, is cause for action against the individual owner/operator. Action against the airworthiness certificate is also possible under this condition.

11. SUMMARY. To sum up, compliance with manufacturer's maintenance instructions is required when:

a. Made mandatory by an AD or other specific rule within the FAR.

b. Made mandatory by a type certificate data sheet. Only maintenance people are subject to this requirement since they have been advised to comply through FAR 43; however, caution must be exercised since an equivalent procedure could be found to be acceptable at an enforcement hearing. The FAA case should show that an equivalent level of safety was not attained. Noncompliance with life limits, placarding instructions, or component configurations specified on a data sheet is always acceptable ground for initiating enforcement action. The enforcement action would be taken against a maintenance entity, the aircraft airworthiness certificate, or both.

J. A. FERRARESE
Acting Director
Flight Standards Service

FEB 14 1979

AFS-130

CONCURRENCES

A300B CAT II Autoland and CAT IIIa; AFS-100 ltr dtd 10/23/78 Status

Chief, Engineering and Manufacturing Division, AFS-100

AEU-100

The current status of 12 items listed in October 23, 1978, letter concerning A300B CAT II autoland and CAT IIIa approval for basic airplane follows:

1. Computer analysis correlation - closed.

2. TSS 1-2 windshear model - open. Need Airbus windshear data to show aircraft system can meet 8 kts/100 feet below 150 feet.

3. Mandatory maintenance requirements - open.

A. Need Airbus Industrie
   (1) Maintenance document listing mandatory AFSC
      a. Maintenance tasks
      b. Task intervals in hours
      c. Component MTBF numbers

   (2) Maintenance document MTBF monitoring program recommendation,

   (3) Maintenance document detailing mandatory maintenance tasks.

AFS-201
RC
2/13

B. Reference for Mandatory Maintenance Requirements. FAA Order 8620.2 dated November 2, 1978, indicates that although owners/operators may not be knowledgeable of data sheet requirements, enforcement action can be taken against an airworthiness certificate. The maintenance document(s) listed above is to be included in the A300B type certificate data sheet.

4. Global safety analysis of extremely improbable numbers - open. FAA review of current documents found insufficient detail to make an assessment which includes documents number 462.527/74, 462.823/74, and 462.835/76. FAA needs appropriate data and Airbus specialist assistance to continue the review.

5. Critical AFCS wiring etc. - open. Need Airbus Industrie revised list to include connectors and bundles in addition to wire numbers. We also need assurance the list is to be included in the maintenance manual of A300B. This method has been found satisfactory in lieu of special marking of critical AFCS wires, bundles, connectors, etc.

6. AFM warnings below 100 feet - closed.

7. Computer analysis vs. flight test touchdown 71 meter offset - open. Need Airbus Industrie terminology defined such as X aimed, and also the cockpit cutoff angle data in order to complete FAA data review.

8. AFM, AFCS supplement review - open. FAA initial review was completed the week of January 15 for Airbus supplement provided October 1978 with a AFS-100/200 check of the AFM recommended change. Several items are open on AFM including single V.G. failure causing loss of AFCS system, engine out procedures, etc. Review with Airbus specialists necessary.

9. Mandatory maintenance task list to be referenced in FAA mandatory document - closed (see item 3b).

10. A300B installation aspects - open. Need english translation of installation document.

11. Flight test program - closed.

12. A300B V ref speed tolerance - open. Airbus to notify FAA of proposed action to resolve this problem.

The AEU's telex dated January 11 suggested a DGAC/FAA/Airbus meeting during the week of February 12. The review necessary for the new data package, scheduled to be mailed to AFS-100 by January 24, will not permit a meeting as suggested. We will advise in mid-February on the place and time for the meeting after our initial review of the Airbus package referenced in the AEU telex.

Original signed by:
James O. Robinson

JAMES C. ROBINSON

Enclosure

cc: AFS-130/131/100/160/203/200/ANW-210/213/ACE-EMDO-43
R.Ruhn:AFS-131:cc:1/22/79:68395

no MC   File No.: ________

AGENDA ITEM 1.2
MAINTENANCE AND ALTERATION
PROGRAMS

PROBLEM:

Maintenance and alterations programs to assure continued compliance with FAR § 25.1309 (Amdt. 25-23 and Subs.). (Reference enclosed item from ASW-210).

STATUS:

TC approvals are considered handled under Agenda Item 1.1. STC and field approvals are still open to resolve procedure.

ACTION:

DISCUSSION: (Ref. Agenda Item 1.1)

ASW-213 pointed to the fact that there are no means to handle mandatory maintenance requirements for general aviation aircraft. Routine or non-routine maintenance on standard instruments and equipent are not expected to have fixed maintenance requirements under 25.1309.

For advanced technology related to flight crucial and flight critical applications (where in-service experience is not available) it is anticipated, that mandatory maintenance concepts may be developed.

FAA has no current procedures for handling these concepts for general aviation.

CONCLUSION:

AWS-130 will investigate the STC data sheet.

AWS-330 will investigate a course of action for mandatory maintenance.

No field approvals for complex systems shall be approved.

ASW-210

MAINTENANCE AND ALTERATION PROGRAMS TO ASSURE CONTINUED COMPLIANCE WITH FAR 25.1309 (Amdt. 25-23 and Subs.)

Background: Amendment 25-23 revised FAR 25.1309 to a form that requires reliability analyses for critical systems. This is being done in initial type certification and major STC programs, but we are concerned with its implementation in field approvals and maintenance programs.

Discussion: FMEA's are prepared at the time of initial type certification for the critical systems. These FMEA's are based on the MTBF of the components in the system, and concentrated engineering judgement.

To assure continued compliance with FAR 25.1309, the components within the critical system must be periodically replaced and/or overhauled to assure that they retain the degree of reliability assured in the FMEA.

For airline operations, overhaul or replacement periods are often well established and readily monitored by the responsible ACDO.

Administration of maintenance requirements to assure continued compliance with the airworthiness rules on general aviation aircraft is less straightforward regarding the 25.1309 and FMEA concept. In addition, their operation/maintenance/overhaul periods and conditions are less well controlled.

There is a greater tendency in general aviation to "customize" each aircraft. This will result in considerable conflict when the new aircraft owner and/or aircraft modifier is required to fund development costs of a complete FMEA for a particular critical system in which gyros, receivers, transmitters, etc., differ from those originally certified.

What special procedures should be implemented to assure continued airworthiness in both alteration and maintenance operations?

Available Options: I. Maintenance

1. Let maintenance take care of it.

2. Work with maintenance, inform them of the situation, review the maintenance rules and recommend changes if necessary, assure maintenance manuals contain the necessary information.

II. Alteration (by STC)

1. Ignore the certification basis and not require the modifier to do FMEA's for critical systems.

2. Require modifiers to do FMEA's the same as the aircraft manufacturer.

III. Field Approvals

1. Let field inspectors take care of it.

2. Advise field inspectors of the certification basis and necessity for FMEA's on critical system modifications.

Analysis of the Options: The FAA Act dictates following option 2 in the maintenance, alteration, and field approval areas.

.ecommendation: Recommend all regions hold a hard line on modifiers of aircraft having certification bases of FAR 25 Amendment 23, and subsequent by requiring them to do FMEA's on critical systems the same as the original airframe manufacturer.

AGENDA ITEM 1.3
SINGLE PILOT IFR-HELICOPTER

PROBLEM:

Draft airworthiness criteria incompatibility between FAR § 27 and § 29 helicopters (Reference 1977 Agenda Item 16).

STATUS:

A complete rewrite of the IFR helicopter criteria has been accomplished and sent to the regions. SFAR § 29-2 has been extended.

ACTION:

AWS-130/160 will advise status at workshop.

AWS-216 to provide all trip reports. All regions to provide available installation data by 1/80.

DISCUSSION:

The current background and status of the single pilot IFR certification was provided. Installation and flight test data are required, in order to support standardized certification efforts.

CONCLUSION:

ASW-216 to provide a copy of each installation and flight test report for each SFAR 29-2 evaluation (in order to make available for this report) by 11/79.

Each region was requested to provide to AWS-130, installation data (available) by 1/80.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SOUTHWEST REGION
P. O. BOX 1689
FORT WORTH, TEXAS 76101

DATE: February 23, 1979

IN REPLY REFER TO: ASW-216

SUBJECT: Flight Test Report for SFAR 29-2, Evaluation of U.S. Steel Agusta 109A Helicopter S/N 7115

FROM: Chief, Flight Test Section, ASW-216

TO: AFS-100
AEA-210
EA-GADO-14, Pittsburgh, Pennsylvania

This letter will serve as a trip report and flight test report to document the results of the SFAR 29-2 engineering evaluation of the Agusta 109A helicopter operated by U.S. Steel in Pittsburgh, Pennsylvania.

After coordination with C. Stockdale, Pittsburgh GADO; R. Ford, AFS-160; R. Barton, AFS-824; J. Plackis, AEA-216; and R. Borowski, AEA-210, during the week of February 12, the undersigned met with Mr. Art Lippa, General Manager of the Aircraft Division, U.S. Steel, at the U.S. Steel Hangar at the Pittsburgh Airport on February 20, 1979.

Mr. Lippa advised that he had made application to the Pittsburgh GADO for IFR operation of their Agusta 109A under SFAR 29-2. A copy of Mr. Lippa's letter to the Pittsburgh GADO is included as Enclosure 1.

On February 16, 1979, AEA-210 had taken the position that only a preliminary evaluation could be accomplished by the undersigned and that the Eastern Region evaluation would take place after a formal application had been made by the operator. (See Enclosure 2.) This suggested an unnecessary duplication of paperwork and a redundant "Eastern Region program" for which there is no apparent need.

I met with Captain Ed Grabski, U.S. Steel helicopter pilot, and we outlined a plan to show compliance with paragraph 2(c) of the SFAR which states: "The conditions and limitations necessary for the safe operation of the rotorcraft in limited IFR operations have been established, approved, and incorporated in the operating limitations section of the Rotorcraft Flight Manual."

The items listed in AFS-100 letter dated February 6, 1979, are addressed in the sequence outlined in the letter.

a. <u>Qualitative Evaluation of the Proposed Flight Envelope</u>

A proposed flight envelope was discussed with Captain Grabski, and it was agreed that we would investigate aft c.g. loadings that were one inch aft of their most aft "standard loadings." This resulted

in a loading at station 133.7 @ 5400 pounds and station 134.2 @ 4850 pounds. Handling qualities investigations were conducted for each configuration. (See Weight and Balance computation forms, enclosure 3.)

An investigation of the proposed envelope was conducted in smooth air by introducing perturbations into the control system (to simulate gust disturbances) and noting the aircraft response. The pulses (longitudinal forward and aft, lateral right and left, and directional right and left) were approximately one inch for approximately one second. The aircraft response was noted after the control was returned to the trimmed position. The handling qualities evaluation resulted in the following determinations:

V_{yi} - Instrument Climb Speed - 90 kts @ 1000 FPM

V_{nei} - Instrument never exceed speed - 130 kts.

V_{mini} - Instrument minimum speed - 60 kts.

These speeds are listed in the proposed Rotorcraft Flight Manual Supplement (Enclosure 4). Using the above speeds, it was determined that the helicopter was free from rapid or excessive divergence. (The helicopter did not exceed $\pm$ 10° pitch or $\pm$ 30° roll from the trimmed condition.)

It should be noted that this helicopter, S/N 7115, is equipped with an excellent force trim system and it was relatively easy to maintain a trim position during the dynamic stability evaluations. (The limitations section of the proposed Rotorcraft Flight Manual requires that the force trim system be on for all IFR operations.) Static longitudinal characteristics, roll due to sideslip, and crew capabilities in the event of emergency conditions were qualitatively evaluated.

Results - Satisfactory.

b. Night Flight

A night flight was conducted in conjunction with the second handling qualities flight (4850 lbs @ 135.0).

The instrument lighting at both pilots' stations was satisfactory. A simulated total electrical failure was conducted by turning off both generators and the battery switch. The J.E.T. independent attitude indicator was well lighted and functioned properly. (A notation was made in the limitations section of the proposed RFM that the emergency power switch shall be on prior to IFR operations.)

Results - Satisfactory.

c. Flight in actual IFR conditions

On February 21 an IFR Flight Plan was filed from the Greater Pittsburgh Airport to Allegheny County Airport. The clearance was radar vectors - climb to 4000'. The weather was 400' overcast, 1/2 mile visibility and rain. During climbout, the clearance was changed to maintain 3000'. The climb was conducted at 100 kts and 1000 FPM. We received radar vectors to intercept the ILS at Allegheny County. The outside air temperature was $+6^{o}$ at 3000 feet.

It was possible to perform the ILS approach within one dot tolerances without exceptional pilot skill. We broke out of the overcast at approximately 500' above ground level. The ILS minima at Allegheny County is 250'.

Results - Satisfactory.

d. Flight in Turbulence

The actual instrument flight was conducted in moderate turbulence (Wind was 20 kts with gusts to 25 kts.). The flight in turbulence verified the results of the previous dynamic stability investigations. Although the turbulence required the pilot to spend considerable attention to the task of flying the helicopter, pilot workload was not considered to be excessive or out of the ordinary for the environmental conditions being experienced. The second pilot handled the communications and navigation radio tasks. The most comfortable airspeed during the approach in turbulence was considered to be 105 - 110 kts.

Results - Satisfactory.

e. Failure Conditions

Hydraulic failures were simulated by selecting individual systems. With the #2 system selected, the directional control forces were high but manageable for IFR operation.

Results - Satisfactory.

Electrical Failure - A total electrical system failure was conducted on the night flight as described in (b).

Results - Satisfactory.

Engine Failure.

Engine failures were simulated and no controllability problems were noted.

Results - Satisfactory.

Equipment

(a) Independent powered attitude indicator

A J.E.T. independently powered attitude indicator was installed. The installation was reviewed with W. Gillen, AEA-219, and J. Baldinger, AEA-216 (AEA-210 observers). It was determined that the emergency power switch must be on prior to IFR operations. (This eliminates the need for any pilot action following a complete electrical failure.).

The requirement was listed in the limitations section of the proposed Rotorcraft Flight Manual Supplement.

Results - Satisfactory.

(b) Protected Pitot - Static System

The Agusta 109A has a heated pitot and static system. This installation was reviewed by W. Gillen, AEA-219.

Results - Satisfactory.

(c) Required Instruments for both Pilot Crewmembers

The U.S. Steel Agusta 109A had an excellent instrument presentation for both pilot crew members. The instrument arrangement is shown in Enclosure 5.

Results - Satisfactory

On February 21 the results of the engineering evaluation were reviewed with the following FAA personnel:

Mr. Dave Kountz - Operations Inspector GADO-14, Pittsburgh, Pa.
Mr. William Frennier - Principal Maintenance Inspector,
GADO-14, Pittsburgh, Pennsylvania
Mr. James Baldinger - Flight Test Pilot, AEA-216
Mr. William Gillen - Electronic Engineer, AEA-219

The undersigned then contacted AEA-210 and recommended approval of the U.S. Steel 109A for operations in accordance with SFAR 29-2. I offered to sign a temporary Rotorcraft Flight Manual Supplement for the installation. Mr. Borowski advised that a temporary RFM supplement would not be granted and that the RFM supplement would be reviewed and approved by AEA-210.

I returned to Fort Worth on the 2:15 flight.

On February 23, the undersigned discussed the engineering evaluation with Mr. J. G. Plackis, Acting Chief, AEA-210, and approval of the RFM supplement was recommended. I advised that the flight test report was being prepared and would be submitted to AEA-210 during the following week.

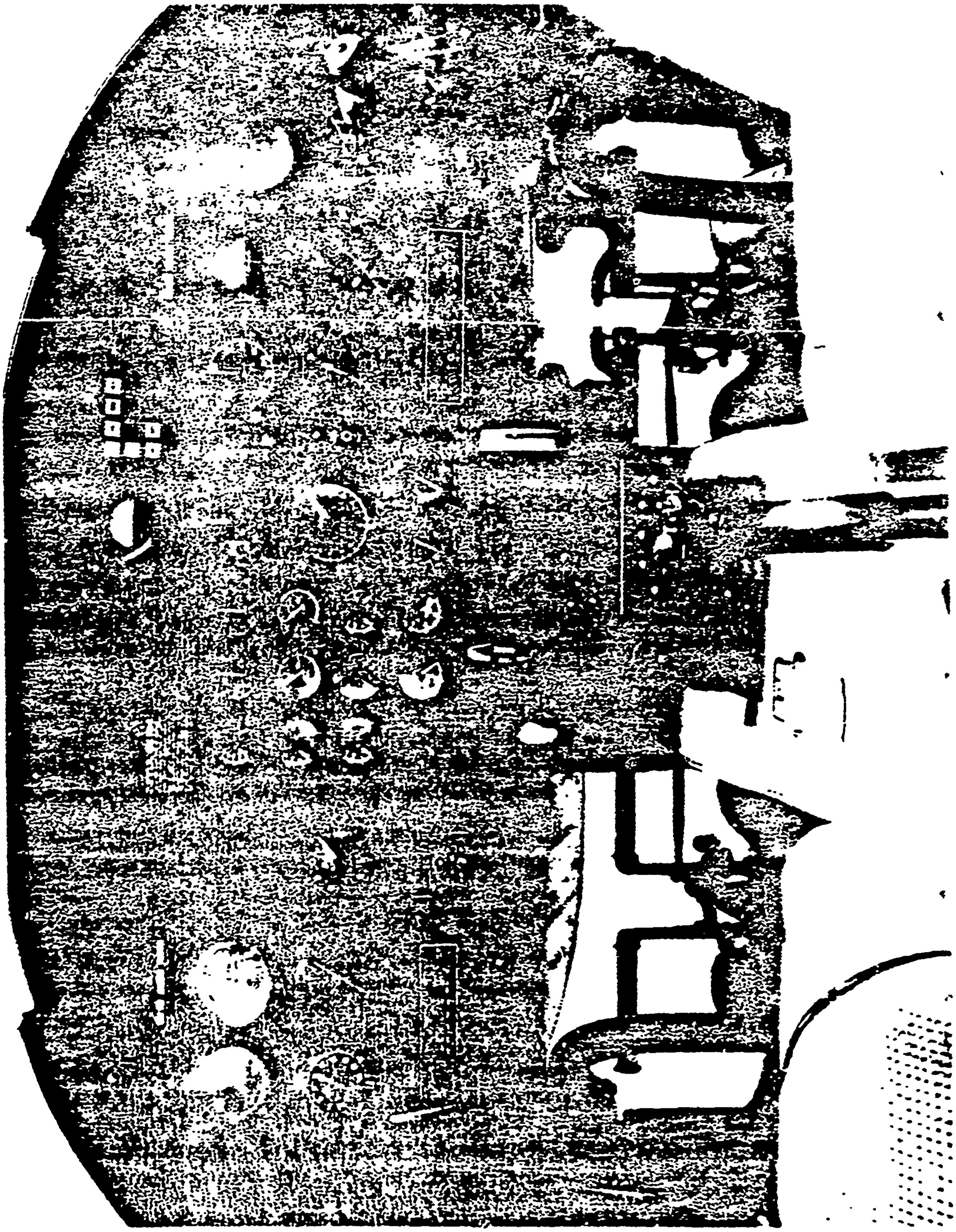
Conclusion. U.S. Steel Agusta 109A meets all requirements of SFAR 29-2 for IFR operations.

Recommendation. Recommend approval - The U.S. Steel Agusta 109A meets all the requirements of SFAR 29-2 and guidelines set forth in AFS-100 letter dated February 6, 1979.

NOTE: This will be the first approval for a FAR 27 helicopter under SFAR 29-2.

R. J. SHAPLEY

5 Enclosures



DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

DATE: March 9, 1979

SOUTHWEST REGION
P O BOX 1689
FORT WORTH, TEXAS 76101

IN REPLY REFER TO: ASW-216

SUBJECT: Flight Test Report for SFAR 29-2 Evaluation of National Mines Bell 206B Helicopter

FROM: Chief, Flight Test Section, ASW-216

TO: AFS-100
ASO-210
SO-GADO-13, Louisville, Kentucky

This letter will serve as a trip report and Flight Test report to document the results of the SFAR 29-2 engineering evaluation of the Bell 206B helicopter operated by National Mines Corporation in Lexington, Kentucky.

In response to the request to ASW-210 by R. Ford, AFS-160, the undersigned coordinated with R. Barton, AFS-824; F. McGowan, ASO-216; and R. Coward, SO-GADO-13, regarding the SFAR 29-2 evaluation of the 206B operated by National Mines in Louisville, Kentucky.

On February 9, 1979, I met with R. Coward and R. Kidder at the Louisville GADO and discussed the proposed evaluation. R. Coward and I flew in a rental aircraft to Lexington, Kentucky, where we met with Clyde Bishop, Chief Helicopter Pilot, National Mines, and R. Barton, AFS-824, D. Ostrowski and R. Gough, AFS-160, who had flown from Washington in an FAA aircraft.

After a general discussion of the SFAR requirements, we proceeded to evaluate the proposed flight envelope and equipment requirements to show compliance with paragraph 2(c) of the SFAR which states: "The conditions and limitations necessary for safe operation of the rotorcraft in limited IFR operations have been established, approved, and incorporated in the operating limitations section of the Rotorcraft Flight Manual."

The items listed in AFS-100 letter dated February 6, 1979, are addressed in the sequence outlined in the letter.

1. Qualitative Evaluation of the Proposed Flight Envelope

proposed flight envelope was discussed with C. Bishop and it was greed that we would investigate the most aft c.g. loadings that ational Mines uses in their operations. The first flight was onducted at a gross weight of 3200 pounds and a c.g. at tation 110.

An investigation of the proposed envelope was conducted in smooth air by introducing perturbations in the control system (to simulate gust disturbances) and noting the aircraft response. The pulses (longitudinal forward and aft, lateral right and left, and directional right and left) were approximately one inch for approximately one second. The aircraft response was noted after the control was returned to the trimmed position. The handling qualities evaluation resulted in the following determinations:

V_{yi} - Instrument Climb Speed - 90 MPH @ 1000 FPM

V_{nei} - Instrument never exceed speed - 120 MPH

V_{mini} - Instrument minimum speed - 60 MPH

This helicopter is equipped with a 3-axis Bell Stability Augmentation System. The SAS was turned off for the handling qualities evaluation. It is the opinion of the undersigned that if a force trim system were installed in conjunction with the Stability Augmentation System that a higher V_{nei} could be approved for the IFR envelope (providing the SAS malfunctions could be accounted for).

The proposed Center of Gravity vs Gross Weight Envelope is shown in the draft proposed Rotorcraft Flight Manual Supplement (Enclosure 1).

Static longitudinal characteristics, roll due to sideslip, and crew capabilities in the event of emergency conditions were qualitatively evaluated.

Results - Satisfactory.

After the first handling qualities flight, R. Barton, AFS-824 and R. Coward, SO-GADO-13, conducted airman certification flight checks with two National Mines pilots. They reported that the airman instrument flight checks were satisfactory.

b. Night Flight

A night flight was conducted in conjunction with the second handling qualities flight. The instrument lighting and the handling qualities were satisfactory.

Results - Satisfactory.

c. Flight in Actual IFR conditions

This item is open pending resolution of the equipment items which are addressed later in this report.

Results - Open item.

d. Flight in Turbulence

During the first flight, turbulence was encountered by flying low over the hills south of Lexington. It was determined that the instrument flight speeds were satisfactory during turbulence. With the SAS on the turbulence effect was not measurable.

Results - Satisfactory.

e. Failure Conditions

A hydraulic failure was simulated by turning off the hydraulic system. It was determined that the control forces and handling qualities were satisfactory for emergency operation.

Results - Satisfactory.

Electrical Failure

This item is open pending resolution of the equipment items which are addressed later in this report.

Engine Failure

Engine failures were simulated and no controllability problems were noted.

Results - Satisfactory.

f Equipment

(a) Independently powered attitude indicator

The National Mines Bell 206B, N-500NM was not equipped with an independently powered attitude indicator. C. Bishop, National Mines is investigating several possible installations. I explained that the installation of an independently powered attitude

indicator is necessary since the existing electrical system was approved for VFR operations which allows for a single fault to result in loss of attitude information. In actual instrument con ions, the results would probably be catastrophic.

Results - Open item.

(b) Protected Pitot - Static System

The Bell 206B, N500NM has a heated pitot and an unprotected static source which is subject to icing. C. Bishop is investigating the installation of an alternate static source.

Results - Open item.

(c) Required instruments for both pilot crew members

The National Mines Bell 206B has an excellent instrument panel which includes an HSI, Dual Comm and NAV Radios, DME, Battery Overtemp Warning, R-NAV and a Transponder. These instruments are located on the pilot's side. R. Barton conducted flight checks by requiring the second pilot to perform maneuvers including approaches from the left side and the applicants performed satisfactorily. It is the opinion of the undersigned that with the addition of a standby attitude indicator, this flight instrument presentation meets the intent of SFAR 29-2 for flight from the primary pilot's station. It is felt that for a second crew member to be required to routinely fly "cross cockpit" is undesirable due to physiological discomforts and the increased probability of vertigo to that crew member.

Note: The guidelines in AFS-1 letter dated January 11, 1979, state that "The minimum flightcrew must include a pilot in command (PIC) and a second in command. A complete set of flight controls must be available at each pilot station." The undersigned believes that consideration should be given for single-pilot approvals if the installations include compensating features such as a stability augmentation system, an HSI presentation, and compliance with the airman certification requirements.

Conclusion: The National Mines Bell 206B meets the requirements of SFAR 29-2 except for the installation of an independently powered attitude indicator, a protected static source and the actual IFR flight by an FAA representative.

5

Recommendation: Recommend approval of the National Mines Bell 206B after FAA evaluation of the independently powered attitude indicator, protected static source and flight in actual IFR conditions. (I advised R. Coward, SO-GADO-13, that he could conduct the evaluation of the open items and that I would be available to assist if necessary.)

NOTE: This will probably be the first approval of a Bell 206B under SFAR 29-2.

J. J. Shapley
J. J. SHAPLEY

Enclosure

D R A F T

National Mines Corporation
P. O. Box 12022
Lexington, Kentucky 40579

BELL 206B

FLIGHT MANUAL SUPPLEMENT

FOR

LIMITED IFR OPERATIONS

FOR

S/N 928
N 500NM

This supplement shall be attached to the Bell Helicopter Company Model 206B Flight Manual dated July 30, 1971.

The information contained herein supplements the information of the basic Flight Manual. For Limitations, Procedures and Performance Data not contained in this supplement, consult the basic Flight Manual.

FAA APPROVED________________________________
Chief, Engineering & Manuf. Branch
Federal Aviation Administration
Department of Transportation
Southern Region, Atlanta, Georgia

DATE: ______________________________

ENCLOSURE 1

MANDATORY COMPLIANCE WITH THE OPERATING LIMITATIONS IN SECTION 1 OF THIS SUPPLEMENT IS REQUIRED BY LAW.

THIS HELICOPTER IS APPROVED FOR DAY AND NIGHT VFR AND IFR IN ACCORDANCE WITH SFAR 29-2, IN NON-ICING CONDITIONS.

AIRSPEED LIMITATIONS

V_{mini} - 60 MPH (minimum airspeed for - instrument flight)

V_{nei} - 120 MPH (never exceed speed - instrument)

V_{yi} - 90 MPH (climb speed - instrument)

ALTITUDE LIMITATIONS

Maximum Operating - 10,000 feet

CENTER OF GRAVITY LIMITS

(See Supplement Page 3)

FLIGHT CREW FOR LIMITED IFR OPERATION

The minimum crew will be a pilot-in-command and second-in-command. Both shall hold commercial or ATP, with helicopter instrument rating.

FAA APPROVED

1.0 REGULATORY/POLICY

AGENDA ITEM 1.1
ENGINEERING/MAINTENANCE
FAR § 25.1309 HANDLING

PROBLEM:

Engineering/Maintenance coordinaton for appropriate guidance material is an open item from two previous workshops (Reference 1977 Agenda Item 14).

STATUS:

Industry groups have not supported the engineering/maintenance concept proposed. FAR § 23-25.1529 maybe utilized for this purpose.

ACTION:

No guidance material in the immediate future is anticipated. However, FAA Order 8620.2 dated November 2, 1978, provides guidance on where and how to list mandatory information.

DISCUSSION: (Ref. Agenda Item 1, 2)

A mandatory maintenance Advisory Circular proposal was strongly opposed by industry and therefore consideration was dropped.

Rulemaking action to insert mandatory maintenance requirements in the Maintenance Manual Rule e.g., 25.1529 have been dropped.

FAA Order 8620.2 has been accepted as guidance as to where and how to list mandatory maintenance information.

Airbus Industrie A300B was the first aircraft utilizing this order.

CONCLUSION:

FAA Order 8620.2 indicates a Type Certificate Data Sheet is an acceptable document for enforcement action, and therefore is being used for mandatory maintenance requirements. AC 25.1309 to be written/published by December 1979.

ORDER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8620.2

11/2/78

SUBJ: APPLICABILITY AND ENFORCEMENT OF MANUFACTURER'S DATA

1. PURPOSE. This order provides information to field personnel concerning the manner in which manufacturer's maintenance manual material, including service letters and service bulletins, could be enforced. This order also discusses conditions for enforcement of the type certificate data sheet or specification.

2. DISTRIBUTION. This order is distributed to Flight Standards in Washington Headquarters, the regions, and the Aeronautical Center to the branch level; to all General Aviation, Air Carrier, Engineering and Manufacturing, and Flight Standards District Offices; and to all International, International Aviation, and Aeronautical Quality Assurance Field Offices.

3. BACKGROUND. There exists a difference of opinion among field inspectors concerning the manner in which manufacturer's maintenance manual material, including service letters and service bulletins, could be enforced by the FAA. FAR 43.13 requires all persons to use methods, techniques, and practices acceptable to the Administrator while performing aircraft maintenance. The manufacturer's maintenance manuals, service bulletins, and service letters have always been regarded as a source of acceptable data for complying with FAR 43.13(a) and (b); however, such acceptability does not, in itself, impose an enforcement or mandatory compliance requirement.

4. ENFORCEMENT. The office of the Chief Counsel has advised that the provisions of the manufacturer's manuals, letters, and bulletins, with relation to specific inspection procedures, may be enforceable by means of an airworthiness directive (AD) or other specific rule. In addition, manufacturer's data contained in a type certificate data sheet or specification may be enforceable under FAR 43.13.

a. An example of an AD is Piper AD 77-23-09, wherein Piper Service Bulletin No. 530 becomes mandatory and enforceable by the following statement contained in the AD: "The manufacturer's specifications and procedures identified and described in this directive are incorporated herein and are made a part hereof pursuant to 5 USC 552(a)(1)." (Ref. Handbook 8040.1A, Airworthiness Directives.)

b. An example of a rule that establishes manufacturer's maintenance inspection criteria as mandatory and enforceable would be FAR 43.15(b), wherein certain inspection criteria for rotorcraft must be performed in accordance with the maintenance manual of the manufacturer concerned. FARs 43.15(c)(2) and 43.16 are other specific examples of regulatory requirements that make manufacturer's procedures mandatory.

Distribution: A-WX (FS)-3; AFS-500 (20 cys); A-FFS 1, 3, 5, 7, 8 (MAX); A-FIA-O (MAX); AAC-950 (80 cys); AAC-840 (1 cy)

Initiated By: AFS-830

5. TYPE CERTIFICATE DATA SHEET. The type certificate data sheet or specification contains conditions, limitations, and terms pertinent to the issuance of a particular type certificate. These limitations are issued under authority of Section 603(a)(2) of the FA Act. The data sheets or specifications are themselves a part of the type certificate per FAR 21.41 and may require adherence to manufacturer's maintenance manual material. FAR 43.13, in pertinent part, requires that each person maintaining or altering, or performing preventive maintenance, shall use methods, techniques, and practices acceptable to the Administrator and do that work in such a manner and use materials of such a quality, that the condition of the aircraft, airframe, aircraft engine, propeller, or appliance worked on will be at least equal to its original or properly altered condition. In general, this means that persons performing maintenance are obligated to establish airworthiness by compliance with the conditions and limitations appearing on the type certificate data sheets or specifications. Thus, enforcement of FAR 43.13(a) and/or (b) is quite possible and feasible against maintenance personnel for noncompliance with the data sheets.

6. DATA SHEET NOTES. The language on some data sheets is subject to close evaluation to determine whether or not it is mandatory or informative. A note that typically reads "maintenance information may be found in the xyz manual" is informative and not mandatory. Thus, the notes on data sheets must be carefully read to determine their true impact.

7. EQUIVALENT PROCEDURES. In a hearing on an enforcement action involving a required maintenance procedure prescribed in a type certificate data sheet, the FAA could be faced with a defense that while the data sheet was not strictly adhered to, an equivalent procedure was employed. This possibility must be considered before initiating enforcement action involving a manufacturer's recommended maintenance practice.

8. LIFE LIMITS AND PLACARDING. Nonadherence to life limits or failure to follow placarding instructions specified in type certificate data sheets are typical examples of where sound enforcement action can be taken against maintenance entities, under FAR 43.13(a) and (b).

9. ENFORCEMENT AGAINST THE AIRWORTHINESS CERTIFICATE. While mechanics are subject to FAR 43 and are expected to establish compliance with type certificate data sheets, owners/operators are not expected to be fully knowledgeable of data sheet requirements. Thus, upon discovering nonadherence to the type certificate data sheets, enforcement action should be directed against the airworthiness certificate of the aircraft. Exceeding life limits of parts or not maintaining the aircraft according to a specific required mandate are examples of causes for action against the airworthiness certificate.

10. ENFORCEMENT AGAINST THE OWNER/OPERATOR. It should be noted that certain operators are given notice to comply with type certificate data sheets through FAR 91.217. Failure of an owner/operator to comply after being duly notified, in the regulations, is cause for action against the individual owner/operator. Action against the airworthiness certificate is also possible under this condition.

11. SUMMARY. To sum up, compliance with manufacturer's maintenance instructions is required when:

a. Made mandatory by an AD or other specific rule within the FAR.

b. Made mandatory by a type certificate data sheet. Only maintenance people are subject to this requirement since they have been advised to comply through FAR 43; however, caution must be exercised since an equivalent procedure could be found to be acceptable at an enforcement hearing. The FAA case should show that an equivalent level of safety was not attained. Noncompliance with life limits, placarding instructions, or component configurations specified on a data sheet is always acceptable ground for initiating enforcement action. The enforcement action would be taken against a maintenance entity, the aircraft airworthiness certificate, or both.

J. A. FERRARESE
Acting Director
Flight Standards Service

FEB 14 1978/9

AFS-130

CONCURRENCES

A300B CAT II Autoland and CAT IIIa; AFS-100 ltr dtd 10/23/78 Status

Chief, Engineering and Manufacturing Division, AFS-100

AEU-100

The current status of 12 items listed in October 23, 1978, letter concerning A300B CAT II autoland and CAT IIIa approval for basic airplane follows:

1. Computer analysis correlation - closed.

2. TSS 1-2 windshear model - open. Need Airbus windshear data to show aircraft system can meet 8 kts/100 feet below 150 feet.

3. Mandatory maintenance requirements - open.

A. Need Airbus Industrie
(1) Maintenance document listing mandatory AFSC
a. Maintenance tasks
b. Task intervals in hours
c. Component MTBF numbers

(2) Maintenance document MTBF monitoring program recommendation,

(3) Maintenance document detailing mandatory maintenance tasks.

B. Reference for Mandatory Maintenance Requirements. FAA Order 8620.2 dated November 2, 1978, indicates that although owners/operators may not be knowledgeable of data sheet requirements, enforcement action can be taken against an airworthiness certificate. The maintenance document(s) listed above is to be included in the A300B type certificate data sheet.

4. Global safety analysis of extremely improbable numbers - open. FAA review of current documents found insufficient detail to make an assessment which includes documents number 462.527/74, 462.823/74, and 462.835/76. FAA needs appropriate data and Airbus specialist assistance to continue the review.

5. Critical AFCS wiring etc. - open. Need Airbus Industrie revised list to include connectors and bundles in addition to wire numbers. We also need assurance the list is to be included in the maintenance manual of A300B. This method has been found satisfactory in lieu of special marking of critical AFCS wires, bundles, connectors, etc.

FAA Form 1360-14 (7-67) OFFICIAL FILE COPY

6. AFM warnings below 100 feet - closed.

7. Computer analysis vs. flight test touchdown 71 meter offset - open. Need Airbus Industrie terminology defined such as X aimed, and also the cockpit cutoff angle data in order to complete FAA data review.

8. AFM, APCS supplement review - open. FAA initial review was completed the week of January 15 for Airbus supplement provided October 1978 with a AFS-100/200 check of the AFM recommended change. Several items are open on AFM including single V.G. failure causing loss of APSC system, engine out procedures, etc. Review with Airbus specialists necessary.

9. Mandatory maintenance task list to be referenced in FAA mandatory document - closed (see item 2b).

10. A300B installation aspects - open. Need english translation of installation document.

11. Flight test program - closed.

12. A300B V ref speed tolerance - open. Airbus to notify FAA of proposed action to resolve this problem.

The AEU's telex dated January 11 suggested a DGAC/FAA/Airbus meeting during the week of February 12. The review necessary for the new data package, scheduled to be mailed to AFS-100 by January 24, will not permit a meeting as suggested. We will advise in mid-February on the place and time for the meeting after our initial review of the Airbus package referenced in the AEU telex.

Original signed by:
James O. Robinson

JAMES O. ROBINSON

Enclosure

cc: AFS-130/131/100/150/203/200/ANW-210/213/ACE-EMDO-43
R.Huhn:AFS-131:cc:1/22/79.68395

no MC File No.: __________

AGENDA ITEM 1.2
MAINTENANCE AND ALTERATION
PROGRAMS

PROBLEM:

Maintenance and alterations programs to assure continued compliance with FAR § 25.1309 (Amdt. 25-23 and Subs.). (Reference enclosed item from ASW-210).

STATUS:

TC approvals are considered handled under Agenda Item 1.1. STC and field approvals are still open to resolve procedure.

ACTION:

DISCUSSION: (Ref. Agenda Item 1.1)

ASW-213 pointed to the fact that there are no means to handle mandatory maintenance requirements for general aviation aircraft. Routine or non-routine maintenance on standard instruments and equipent are not expected to have fixed maintenance requirements under 25.1309.

For advanced technology related to flight crucial and flight critical applications (where in-service experience is not available) it is anticipated, that mandatory maintenance concepts may be developed.

FAA has no current procedures for handling these concepts for general aviation.

CONCLUSION:

AWS-130 will investigate the STC data sheet.

AWS-330 will investigate a course of action for mandatory mainterance.

No field approvals for complex systems shall be approved.

ASW-210

MAINTENANCE AND ALTERATION PROGRAMS TO ASSURE CONTINUED COMPLIANCE WITH FAR 25.1309 (Amdt. 25-23 and Subs.)

Background: Amendment 25-23 revised FAR 25.1309 to a form that requires reliability analyses for critical systems. This is being done in initial type certification and major STC programs, but we are concerned with its implementation in field approvals and maintenance programs.

Discussion: FMEA's are prepared at the time of initial type certification for the critical systems. These FMEA's are based on the MTBF of the components in the system, and concentrated engineering judgement.

To assure continued compliance with FAR 25.1309, the components within the critical system must be periodically replaced and/or overhauled to assure that they retain the degree of reliability assured in the FMEA.

For airline operations, overhaul or replacement periods are often well established and readily monitored by the responsible ACDO.

Administration of maintenance requirements to assure continued compliance with the airworthiness rules on general aviation aircraft is less straightforward regarding the 25.1309 and FMEA concept. In addition, their operation/maintenance/overhaul periods and conditions are less well controlled.

There is a greater tendency in general aviation to "customize" each aircraft. This will result in considerable conflict when the new aircraft owner and/or aircraft modifier is required to fund development costs of a complete FMEA for a particular critical system in which gyros, receivers, transmitters, etc., differ from those originally certified.

What special procedures should be implemented to assure continued airworthiness in both alteration and maintenance operations?

Available Options: I. Maintenance

1. Let maintenance take care of it.

2. Work with maintenance, inform them of the situation, review the maintenance rules and recommend changes if necessary, assure maintenance manuals contain the necessary information.

II. Alteration (by STC)

1. Ignore the certification basis and not require the modifier to do FMEA's for critical systems.

2. Require modifiers to do FMEA's the same as the aircraft manufacturer.

III. Field Approvals

1. Let field inspectors take care of it.

2. Advise field inspectors of the certification basis and necessity for FMEA's on critical system modifications.

Analysis of the Options: The FAA Act dictates following option 2 in the maintenance, alteration, and field approval areas.

.ecommendation: Recommend all regions hold a hard line on modifiers of aircraft having certification bases of FAR 25 Amendment 23, and subsequent by requiring them to do FMEA's on critical sysrems the same as the original airframe manufacturer.

AGENDA ITEM 1.3
SINGLE PILOT IFR-HELICOPTER

PROBLEM:

Draft airworthiness criteria incompatibility between FAR § 27 and § 29 helicopters (Reference 1977 Agenda Item 16).

STATUS:

A complete rewrite of the IFR helicopter criteria has been accomplished and sent to the regions. SFAR § 29-2 has been extended.

ACTION:

AWS-130/160 will advise status at workshop.

AWS-216 to provide all trip reports. All regions to provide available installation data by 1/80.

DISCUSSION:

The current background and status of the single pilot IFR certification was provided. Installation and flight test data are required, in order to support standardized certification efforts.

CONCLUSION:

ASW-216 to provide a copy of each installation and flight test report for each SFAR 29-2 evaluation (in order to make available for this report) by 11/79.

Each region was requested to provide to AWS-130, installation data (available) by 1/80.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SOUTHWEST REGION
P. O. BOX 1689
FORT WORTH, TEXAS 76101

DATE: February 28, 1979

IN REPLY REFER TO: ASW-216

SUBJECT: Flight Test Report for SFAR 29-2, Evaluation of U.S. Steel Agusta 109A Helicopter S/N 7115

FROM: Chief, Flight Test Section, -216

TO: AFS-100
AEA-210
EA-GADO-14, Pittsburgh, Pennsylvania

This letter will serve as a trip report and flight test report to document the results of the SFAR 29-2 engineering evaluation of the Agusta 109A helicopter operated by U.S. Steel in Pittsburgh, Pennsylvania.

After coordination with C. Stockdale, Pittsburgh GADO; R. Ford, AFS-160; R. Barton, AFS-824; J. Plackis, AEA-216; and R. Borowski, AEA-210, during the week of February 12, the undersigned met with Mr. Art Lippa, General Manager of the Aircraft Division, U.S. Steel, at the U.S. Steel Hangar at the Pittsburgh Airport on February 20, 1979.

Mr. Lippa advised that he had made application to the Pittsburgh GADO for IFR operation of their Agusta 109A under SFAR 29-2. A copy of Mr. Lippa's letter to the Pittsburgh GADO is included as Enclosure 1.

On February 16, 1979, AEA-210 had taken the position that only a preliminary evaluation could be accomplished by the undersigned and that the Eastern Region evaluation would take place after a formal application had been made by the operator. (See Enclosure 2.) This suggested an unnecessary duplication of paperwork and a redundant "Eastern Region program" for which there is no apparent need.

I met with Captain Ed Grabski, U.S. Steel helicopter pilot, and we outlined a plan to show compliance with paragraph 2(c) of the SFAR which states: "The conditions and limitations necessary for the safe operation of the rotorcraft in limited IFR operations have been established, approved, and incorporated in the operating limitations section of the Rotorcraft Flight Manual."

The items listed in AFS-100 letter dated February 6, 1979, are addressed in the sequence outlined in the letter.

a. Qualitative Evaluation of the Proposed Flight Envelope

A proposed flight envelope was discussed with Captain Grabski, and it was agreed that we would investigate aft c.g. loadings that were one inch aft of their most aft "standard loadings." This resulted

in a loading at station 133.7 @ 5400 pounds and station 134.2 @ 4850 pounds. Handling qualities investigations were conducted for each configuration. (See Weight and Balance computation forms, enclosure 3.)

An investigation of the proposed envelope was conducted in smooth air by introducing perturbations into the control system (to simulate gust disturbances) and noting the aircraft response. The pulses (longitudinal forward and aft, lateral right and left, and directional right and left) were approximately one inch for approximately one second. The aircraft response was noted after the control was returned to the trimmed position. The handling qualities evaluation resulted in the following determinations:

V_{yi} - Instrument Climb Speed - 90 kts @ 1000 FPM

V_{nei} - Instrument never exceed speed - 130 kts.

V_{mini} - Instrument minimum speed - 60 kts.

These speeds are listed in the proposed Rotorcraft Flight Manual Supplement (Enclosure 4). Using the above speeds, it was determined that the helicopter was free from rapid or excessive divergence. (The helicopter did not exceed $\pm$ 10° pitch or $\pm$ 30° roll from the trimmed condition.)

It should be noted that this helicopter, S/N 7115, is equipped with an excellent force trim system and it was relatively easy to maintain a trim position during the dynamic stability evaluations. (The limitations section of the proposed Rotorcraft Flight Manual requires that the force trim system be on for all IFR operations.) Static longitudinal characteristics, roll due to sideslip, and crew capabilities in the event of emergency conditions were qualitatively evaluated.

Results - Satisfactory.

b. Night Flight

A night flight was conducted in conjunction with the second handling qualities flight (4850 lbs @ 135.0).

The instrument lighting at both pilots' stations was satisfactory. A simulated total electrical failure was conducted by turning off both generators and the battery switch. The J.E.T. independent attitude indicator was well lighted and functioned properly. (A notation was made in the limitations section of the proposed RFM that the emergency power switch shall be on prior to IFR operations.)

Results - Satisfactory.

c. Flight in actual IFR conditions

On February 21 an IFR Flight Plan was filed from the Greater Pittsburgh Airport to Allegheny County Airport. The clearance was radar vectors - climb to 4000'. The weather was 400' overcast, 1/2 mile visibility and rain. During climbout, the clearance was changed to maintain 3000'. The climb was conducted at 100 kts and 1000 FPM. We received radar vectors to intercept the ILS at Allegheny County. The outside air temperature was +6° at 3000 feet.

It was possible to perform the ILS approach within one dot tolerances without exceptional pilot skill. We broke out of the overcast at approximately 500' above ground level. The ILS minima at Allegheny County is 250'.

Results - Satisfactory.

d. Flight in Turbulence

The actual instrument flight was conducted in moderate turbulence (Wind was 20 kts with gusts to 25 kts.). The flight in turbulence verified the results of the previous dynamic stability investigations. Although the turbulence required the pilot to spend considerable attention to the task of flying the helicopter, pilot workload was not considered to be excessive or out of the ordinary for the environmental conditions being experienced. The second pilot handled the communications and navigation radio tasks. The most comfortable airspeed during the approach in turbulence was considered to be 105 - 110 kts.

Results - Satisfactory.

e. Failure Conditions

Hydraulic failures were simulated by selecting individual systems. With the #2 system selected, the directional control forces were high but manageable for IFR operation.

Results - Satisfactory.

Electrical Failure - A total electrical system failure was conducted on the night flight as described in (b).

Results - Satisfactory.

Engine Failure.

Engine failures were simulated and no controllability problems were noted.

Results - Satisfactory.

Equipment

(a) Independent powered attitude indicator

A J.E.T. independently powered attitude indicator was installed. The installation was reviewed with W. Gillen, AEA-219, and J. Baldinger, AEA-216 (AEA-210 observers). It was determined that the emergency power switch must be on prior to IFR operations. (This eliminates the need for any pilot action following a complete electrical failure.).

The requirement was listed in the limitations section of the proposed Rotorcraft Flight Manual Supplement.

Results - Satisfactory.

(b) Protected Pitot - Static System

The Agusta 109A has a heated pitot and static system. This installation was reviewed by W. Gillen, AEA-219.

Results - Satisfactory.

(c) Required Instruments for both Pilot Crewmembers

The U.S. Steel Agusta 109A had an excellent instrument presentation for both pilot crew members. The instrument arrangement is shown in Enclosure 5.

Results - Satisfactory

On February 21 the results of the engineering evaluation were reviewed with the following FAA personnel:

Mr. Dave Kountz - Operations Inspector GADO-14, Pittsburgh, Pa.
Mr. William Frennier - Principal Maintenance Inspector, GADO-14, Pittsburgh, Pennsylvania
Mr. James Baldinger - Flight Test Pilot, AEA-216
Mr. William Gillen - Electronic Engineer, AEA-219

The undersigned then contacted AEA-210 and recommended approval of the U.S. Steel 109A for operations in accordance with SFAR 29-2. I offered to sign a temporary Rotorcraft Flight Manual Supplement for the installation. Mr. Borowski advised that a temporary RFM supplement would not be granted and that the RFM supplement would be reviewed and approved by AEA-210.

I returned to Fort Worth on the 2:15 flight.

On February 23, the undersigned discussed the engineering evaluation with Mr. J. G. Piackis, Acting Chief, AEA-210, and approval of the RFM supplement was recommended. I advised that the flight test report was being prepared and would be submitted to AEA-210 during the following week.

Conclusion. U.S. Steel Agusta 109A meets all requirements of SFAR 29-2 for IFR operations.

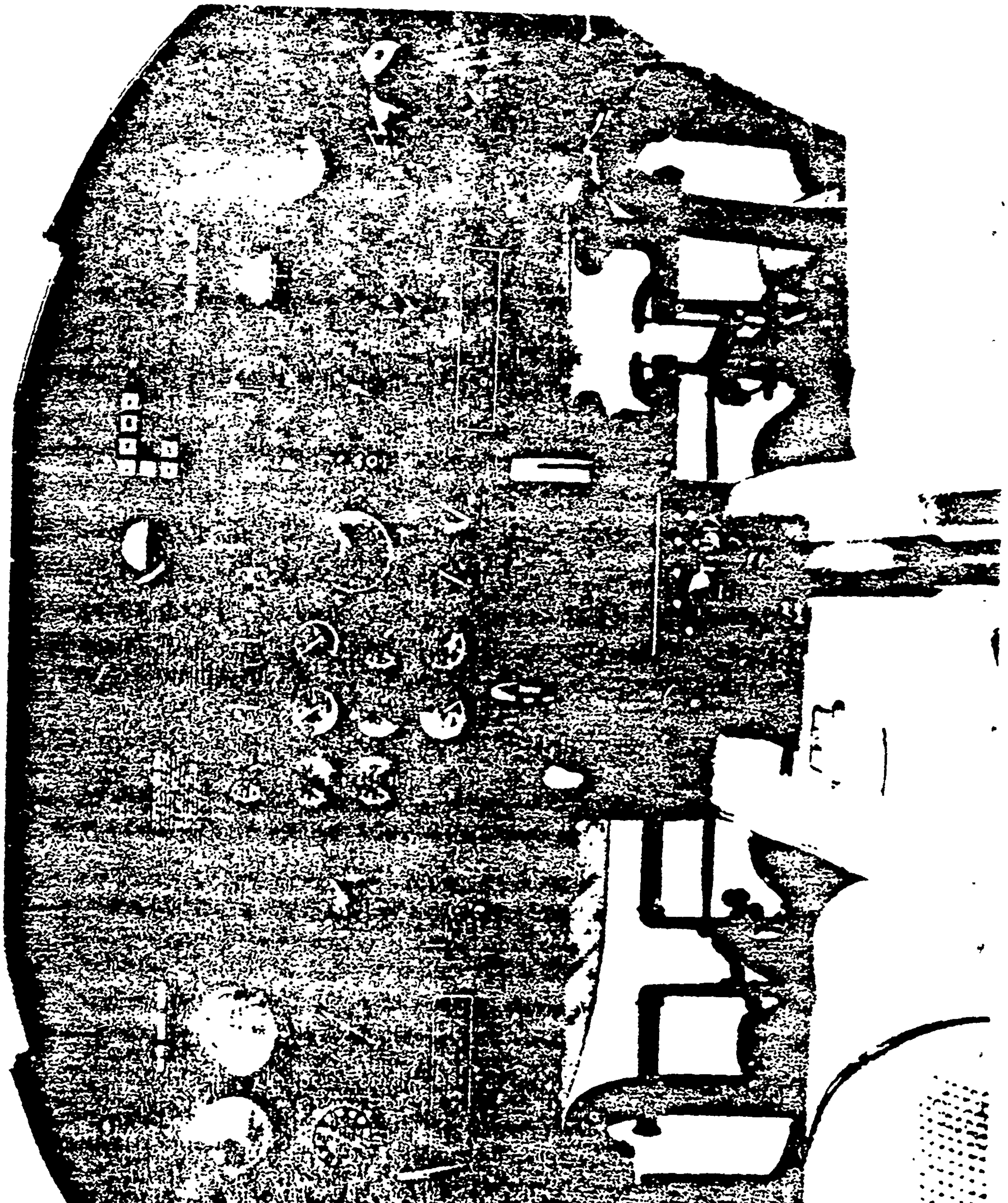
Recommendation. Recommend approval - The U.S. Steel Agusta 109A meets all the requirements of SFAR 29-2 and guidelines set forth in AFS-100 letter dated February 6, 1979.

NOTE: This will be the first approval for a FAR 27 helicopter under SFAR 29-2.

R. J. Shapley

R. J. SHAPLEY

5 Enclosures



DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SOUTHWEST REGION
P O BOX 1689
FORT WORTH, TEXAS 76101

DATE: March 9, 1979

IN REPLY REFER TO: ASW-216

SUBJECT: Flight Test Report for SFAR 29-2 Evaluation of National Mines Bell 206B Helicopter

FROM: Chief, Flight Test Section, ASW-216

TO: AFS-100
ASO-210
SO-GADO-13, Louisville, Kentucky

This letter will serve as a trip report and Flight Test report to document the results of the SFAR 29-2 engineering evaluation of the Bell 206B helicopter operated by National Mines Corporation in Lexington, Kentucky.

In response to the request to ASW-210 by R. Ford, AFS-160, the undersigned coordinated with R. Barton, AFS-824; F. McGowan, ASO-216; and R. Coward, SO-GADO-13, regarding the SFAR 29-2 evaluation of the 206B operated by National Mines in Louisville, Kentucky.

On February 9, 1979, I met with R. Coward and R. Kidder at the Louisville GADO and discussed the proposed evaluation. R. Coward and I flew in a rental aircraft to Lexington, Kentucky, where we met with Clyde Bishop, Chief Helicopter Pilot, National Mines, and R. Barton, AFS-824, D. Ostrowski and R. Gough, AFS-160, who had flown from Washington in an FAA aircraft.

After a general discussion of the SFAR requirements, we proceeded to evaluate the proposed flight envelope and equipment requirements to show compliance with paragraph 2(c) of the SFAR which states· "The conditions and limitations necessary for safe operation of the rotorcraft in limited IFR operations have been established, approved, and incorporated in the operating limitations section of the Rotorcraft Flight Manual."

The items listed in AFS-100 letter dated February 6, 1979, are addressed in the sequence outlined in the letter.

1. ualitative Evaluation of the Proposed Flight Envelope

proposed flight envelope was discussed with C. Bishop and it was greed that we would investigate the most aft c.g. loadings that ational Mines uses in their operations. The first flight was onducted at a gross weight of 320C pounds and a c.g. at tation 110.

An investigation of the proposed envelope was conducted in smooth air by introducing perturbations in the control system (to simulate gust disturbances) and noting the aircraft response. The pulses (longitudinal forward and aft, lateral right and left, and directional right and left) were approximately one inch for approximately one second. The aircraft response was noted after the control was returned to the trimmed position. The handling qualities evaluation resulted in the following determinations:

V_{yi} - Instrument Climb Speed - 90 MPH @ 1000 FPM

V_{nei} - Instrument never exceed speed - 120 MPH

V_{mini} - Instrument minimum speed - 60 MPH

This helicopter is equipped with a 3-axis Bell Stability Augmentation System. The SAS was turned off for the handling qualities evaluation. It is the opinion of the undersigned that if a force trim system were installed in conjunction with the Stability Augmentation System that a higher V_{nei} could be approved the IFR envelope (providing the SAS malfunctions could be accounted for).

The proposed Center of Gravity vs Gross Weight Envelope is shown in the draft proposed Rotorcraft Flight Manual Supplement (Enclosure 1).

Static longitudinal characteristics, roll due to sideslip, and crew capabilities in the event of emergency conditions were qualitatively evaluated.

Results - Satisfactory.

After the first handling qualities flight, R. Barton, AFS-824 and R. Coward, SO-GADO-13, conducted airman certification flight checks with two National Mines pilots. They reported that the airman instrument flight checks were satisfactory.

b. Night Flight

A night flight was conducted in conjunction with the second handling qualities flight. The instrument lighting and the handling qualities were satisfactory.

Results - Satisfactory.

c. Flight in Actual IFR conditions

This item is open pending resolution of the equipment items which are addressed later in this report.

Results - Open item.

d. Flight in Turbulence

During the first flight, turbulence was encountered by flying low over the hills south of Lexington. It was determined that the instrument flight speeds were satisfactory during turbulence. With the SAS on the turbulence effect was not measurable.

Results - Satisfactory.

e. Failure Conditions

A hydraulic failure was simulated by turning off the hydraulic system. It was determined that the control forces and handling qualities were satisfactory for emergency operation.

Results - Satisfactory.

Electrical Failure

This item is open pending resolution of the equipment items which are addressed later in this report.

Engine Failure

Engine failures were simulated and no controllability problems were noted.

Results - Satisfactory.

f Equipment

(a) Independently powered attitude indicator

The National Mines Bell 206B, N-500NM was not equipped with an independently powered attitude indicator. C. Bishop, National Mines is investigating several possible installations. I explained that the installation of an independently powered attitude

indicator is necessary since the existing electrical system was approved for VFR operations which allows for a single fault to result in loss of attitude information. In actual instrument conditions, the results would probably be catastrophic.

Results - Open item.

(b) Protected Pitot - Static System

The Bell 206B, N500NM has a heated pitot and an unprotected static source which is subject to icing. C. Bishop is investigating the installation of an alternate static source.

Results - Open item.

(c) Required instruments for both pilot crew members

The National Mines Bell 206B has an excellent instrument panel which includes an HSI, Dual Comm and NAV Radios, DME, Battery Overtemp Warning, R-NAV and a Transponder. These instruments are located on the pilot's side. R. Barton conducted flight checks by requiring the second pilot to perform maneuvers including approaches from the left side and the applicants performed satisfactorily. It is the opinion of the undersigned that with the addition of a standby attitude indicator, this flight instrument presentation meets the intent of SFAR 29-2 for flight from the primary pilot's station. It is felt that for a second crew member to be required to routinely fly "cross cockpit" is undesirable due to physiological discomforts and the increased probability of vertigo to that crew member.

Note: The guidelines in AFS-1 letter dated January 11, 1979, state that "The minimum flightcrew must include a pilot in command (PIC) and a second in command. A complete set of flight controls must be available at each pilot station." The undersigned believes that consideration should be given for single-pilot approvals if the installations include compensating features such as a stability augmentation system, an HSI presentation, and compliance with the airman certification requirements.

Conclusion: The National Mines Bell 206B meets the requirements of SFAR 29-2 except for the installation of an independently powered attitude indicator, a protected static source and the actual IFR flight by an FAA representative.

5

Recommendation: Recommend approval of the National Mines Bell 206B after FAA evaluation of the independently powered attitude indicator, protected static source and flight in actual IFR conditions. (I advised R. Coward, SO-GADO-13, that he could conduct the evaluation of the open items and that I would be available to assist if necessary.)

NOTE: This will probably be the first approval of a Bell 206B under SFAR 29-2.

J. J. Shapley

J. J. SHAPLEY

Enclosure

D R A F T

National Mines Corporation
P. O. Box 12022
Lexington, Kentucky 40579

BELL 206B

FLIGHT MANUAL SUPPLEMENT

FOR

LIMITED IFR OPERATIONS

FOR

S/N 928
N 500NM

This supplement shall be attached to the Bell Helicopter Company Model 206B Flight Manual dated July 30, 1971.

The information contained herein supplements the information of the basic Flight Manual. For Limitations, Procedures and Performance Data not contained in this supplement, consult the basic Flight Manual.

FAA APPROVED ______________________

Chief, Engineering & Manuf. Branch
Federal Aviation Administration
Department of Transportation
Southern Region, Atlanta, Georgia

DATE: ______________________

ENCLOSURE 1

MANDATORY COMPLIANCE WITH THE OPERATING LIMITATIONS IN SECTION 1 OF THIS SUPPLEMENT IS REQUIRED BY LAW.

THIS HELICOPTER IS APPROVED FOR DAY AND NIGHT VFR AND IFR IN ACCORDANCE WITH SFAR 29-2, IN NON-ICING CONDITIONS.

AIRSPEED LIMITATIONS

V_{mini} - 60 MPH (minimum airspeed for - instrument flight)

V_{nei} - 120 MPH (never exceed speed - instrument)

V_{yi} - 90 MPH (climb speed - instrument)

ALTITUDE LIMITATIONS

Maximum Operating - 10,000 feet

CENTER OF GRAVITY LIMITS

(See Supplement Page 3)

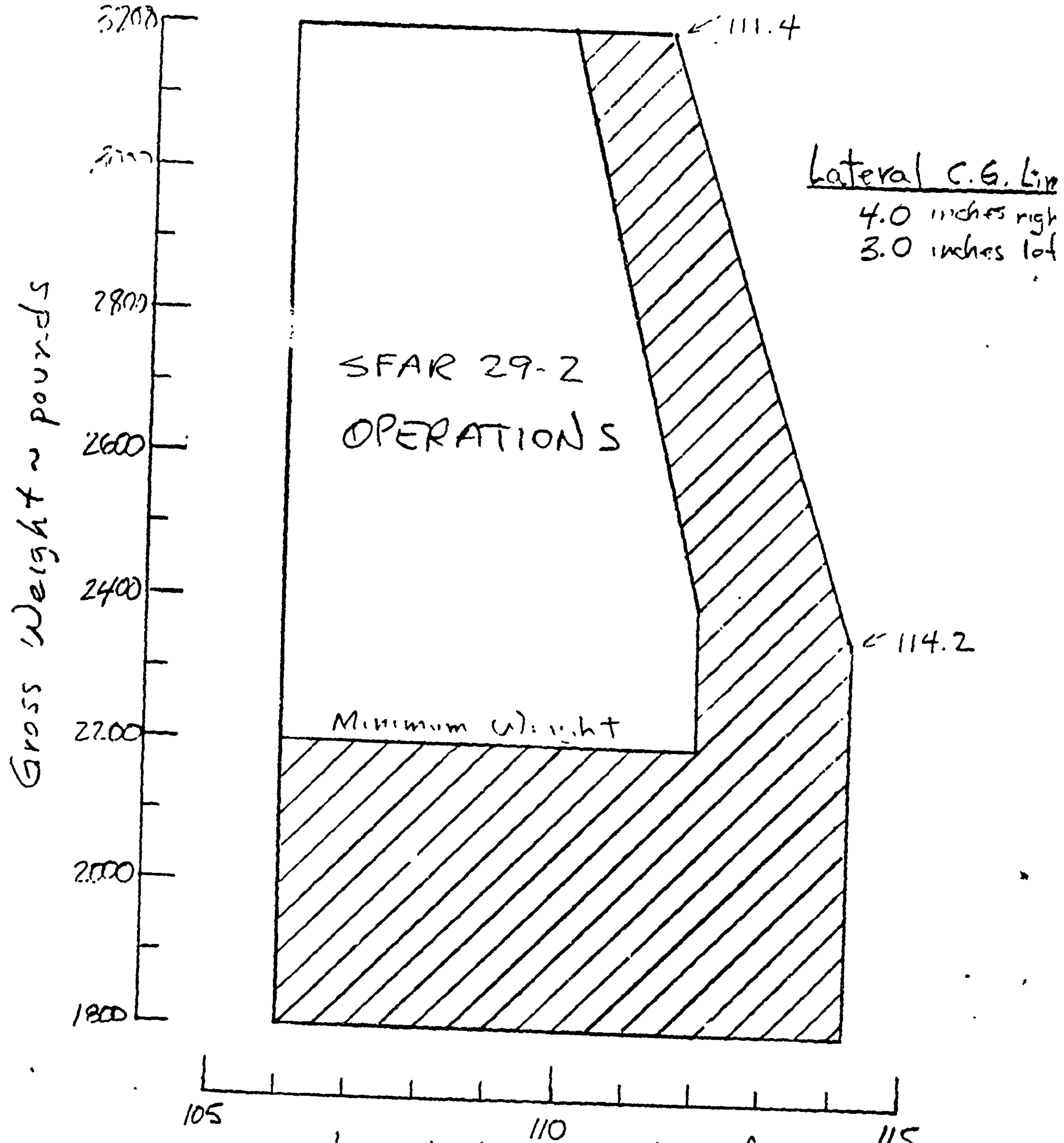
FLIGHT CREW FOR LIMITED IFR OPERATION

The minimum crew will be a pilot-in-command and second-in-command. Both shall hold commercial or ATP, with helicopter instrument rating.

FAA APPROVED

National Mines Corp
P. O. Box 12022
Lexington, Kentucky

CENTER OF GRAVITY vs GROSS WEIGHT



FAA Approved ______ 4

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SOUTHWEST REGION
P. O. BOX 1689
FORT WORTH, TEXAS 76101

DATE: May 21, 1979

IN REPLY REFER TO: ASW-216

SUBJECT: Flight Test Report for SFAR 29-2 Evaluation of Jet Fleet Bell 206B Helicopter

FROM: Chief, Flight Test Section, ASW-216

TO: AFS-100
ASW-210
SW-GADO-2, Dallas, Texas

This letter will serve as the Flight Test Report to document the results of the SFAR 29-2 engineering evaluation of the Bell 206B helicopter operated by Jet Fleet Corporation at Love Field, Dallas, Texas.

On April 4, 1979, I met with Dallas GADO Inspectors Paul Faidley and Jeff Outlaw, and Mr. Don Harvey, Chief Flight Instructor for Helicopter Training, Jet Fleet, Love Field, Dallas, Texas.

We discussed the SFAR requirements and it was agreed that Jet Fleet would provide an independently powered attitude indicator and an alternate static source.

a. Qualitative Evaluation of Proposed Flight Envelope

On April 5, 1979, the undersigned conducted a qualitative evaluation of the proposed flight envelope and a night flight evaluation. Data were gathered on the alternate static system and provided to Jeff Outlaw, Dallas GADO.

The proposed envelope evaluated was the same as previously approved envelope for the National Mines Bell 206B. The limitations and center of gravity vs gross weight envelope are shown in the proposed AFM Supplement (Enclosure 1).

The results were satisfactory.

b. Night Flight

A night flight was conducted and the instrument lighting was satisfactory.

Results - Satisfactory.

c. Flight in actual IFR conditions

A flight in actual IFR conditions was conducted on April 18, 1979. An ILS approach to Meacham Field was accomplished with a 400' ceiling.

Results - Satisfactory.

d. Flight in turbulence

This was not necessary since the helicopter is the same as the previously approved Bell 206B.

e. Failure conditions

Hydraulic, electric, and engine failures were simulated and no problems were noted.

Results - Satisfactory.

f. Equipment

(a) Independently powered attitude indicator

The Jet Fleet 206B, N59395, S/N 1166, was equipped with an independently powered attitude indicator. The installation was checked several times and found satisfactory.

Results - Satisfactory.

(b) Protected Pitot-Static System

The Bell 206B, N59395, has a heated pitot system and an alternate static system. Flight test results of the alternate static system were presented to Jeff Outlaw, Dallas GADO Maintenance Inspector and found satisfactory.

Results - Satisfactory.

(c) Required instruments for both pilot crew members

The Jet Fleet 206B is used for helicopter instrument training. The instructor occupies the left seat and can utilize the student pilots instruments. The standby attitude indicator is located in the center of the panel and can be easily seen by the instructor pilot.

The Jet Fleet 206B has an excellent instrument panel layout and is very well equipped for instrument flight. The installed equipment includes:

Primary and standby attitude indicators
Horizontal situation indicator (#1 VOR & DME)
Dual COMM/NAV
ADF
Transponder
DME
Force Trim (SFENA)
Dual Battery with temp indicators
Stability Augmentation System (SFENA)

NOTE: The SFENA Stability Augmentation System is considered an optional item for this approval. The SFENA force trim system is a required item. (See RFM Supplement, Enclosure 1).

In view of the excellent instrument panel layout and the installed equipment, it is recommended that the flight crew for Limited IFR Operation be a single pilot who holds at least a commercial pilot's certificate with a rotorcraft helicopter rating and an instrument rating. (This will enable Jet Fleet to conduct instrument training under actual IFR conditions and should prove to be more beneficial to the student).

The Proposed Rotorcraft Flight Manual Supplement was tentatively approved pending revised policy to permit single pilot operations under SFAR 29-2.

As of this date, the revised policy has not been approved and the Jet Fleet approval has not been granted.

NOTE: This will probably be the first single-pilot approval under SFAR 29-2 (if the proposed policy letter is approved by AFS-1).

CONCLUSION: The Jet Fleet Bell 206B meets the requirements of SFAR 29-2.

RECOMMENDATION: Recommend approval of the Jet Fleet Bell 206B.

P. J. SHAPLEY

Enclosure

JET FLEET CORPORATION
P.O. Box 7445
Dallas, TX 75209

BELL 206B
FLIGHT MANUAL SUPPLEMENT

FOR

LIMITED IFR OPERATIONS

FOR

SN 1166
N59395

This supplement shall be attached to the Bell Helicopter Company Model 206B Flight Manual Dated

The information contained herein supplements the information of the Basic Flight Manual. For limitations, procedures and performance data not contained in this supplement, consult the Basic Flight Manual.

FAA Approved: ______________________
Chief, Engineering & Manuf. Branch
Federal Aviation Administration
Department of Transportation
Southwest Region, Ft. Worth, TX

Date: ______________________

Enclosure

MANDATORY COMPLIANCE WITH THE OPERATING LIMITATIONS IN SECTION 1 OF THIS SUPPLEMENT IS REQUIRED BY LAW.

THIS HELICOPTER IS APPROVED FOR DAY AND NIGHT VFR AND IFR IN ACCORDANCE WITH THE SFAR 29-2, IN NON-ICING CONDITIONS.

AIRSPEED LIMITATIONS

V_{mini} - 60 mph (minimum Airspeed for instrument flight)
V_{nei} - 120 mph (never exceed speed for instrument)
V_{yi} - 105 mph (climb speed instrument)

ALTITUDE LIMITATIONS

Maximum Operating - 10,000 feet

CENTER OF GRAVITY LIMITS

See supplement page 3

FLIGHT CREW FOR LIMITED IFR OPERATION

The minimum crew will be a single pilot who holds at least a commercial pilot's certificate with a rotorcraft helicopter rating and an instrument rating.

FORCE TRIM

Force trim must be on all IFR operations.

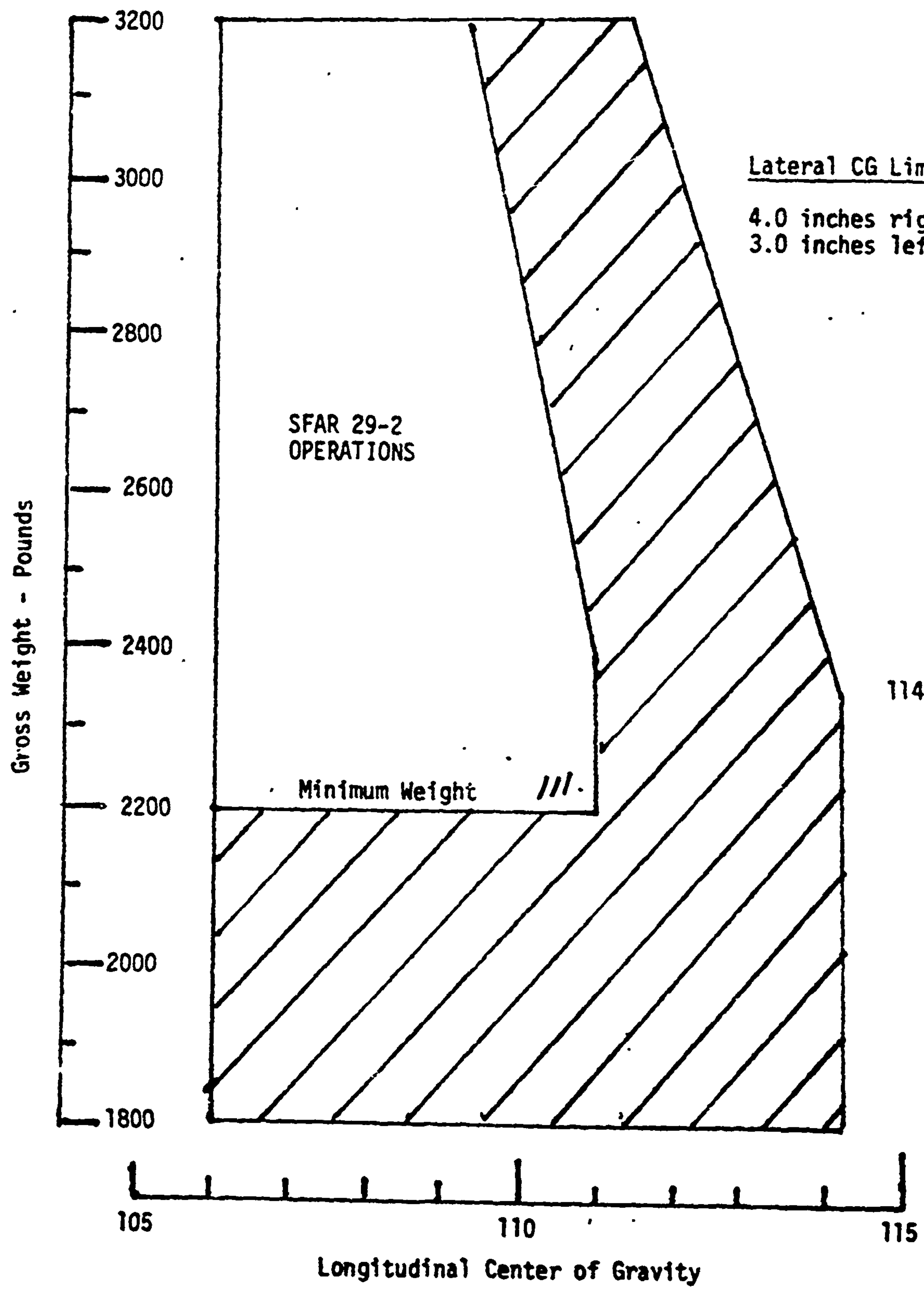
EMERGENCY POWER

Emergency power switch shall be on prior to IFR operations (to power standby).

FAA APPROVED:____________________

Dallas, TX 75209

CENTER OF GRAVITY vs GROSS WEIGHT



Lateral CG Limits

4.0 inches right
3.0 inches left

AWS-130

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SOUTHWEST REGION
P. O. BOX 1689
FORT WORTH, TEXAS 76101

DATE: December 28, 1979

IN REPLY REFER TO: ASW-216

SUBJECT: Flight Test Report for SFAR 29-2 evaluation of Iowa Public Service Company, Bell 206B helicopter

FROM: Chief, Flight Test Section, ASW-216

TO: CE-GADO-4, Des Moines, Iowa
AFS-100
ACE-200
CE-EMDO-43, Wichita, Kansas

This letter will serve as the Flight Test Report to document the results of the SFAR 29-2 engineering evaluation of the Bell 206B helicopter operated by Iowa Public Service Company, Sioux City, Iowa.

On December 18, 1979, I met with Inspectors Wesley Murphy, Michael Roche, and Robert Glascock (GADO-4,Des Moines, Iowa), and R. Parduhn, Flight Test Pilot (EMDC-43, Wichita, Kansas). The meeting was held at the airport in Sioux City, Iowa.

We discussed the SFAR requirements and the following tests were conducted:

1. QUALITATIVE EVALUATION OF THE PROPOSED FLIGHT ENVELOPE

   On December 18, 1979, the undersigned conducted a qualitative evaluation of the proposed flight envelope and a night flight evaluation. The proposed envelope was the same as the previously approved envelope for the Jet Fleet 206B helicopter. The limitations and center of gravity vs gross weight envelope are shown in the RFM Supplement (Enclosure 1).

   Results - Satisfactory.

2. NIGHT FLIGHT

   A night flight was conducted and the instrument lighting was evaluated.

   Results - Satisfactory.

3. FLIGHT IN ACTUAL IFR CONDITIONS

   It was determined that a flight in actual IFR conditions was not required due to similarity to the previously approved Jet Fleet 206B helicopter.

4. FLIGHT IN TURBULENCE

   This test was not necessary since the helicopter is the same as the previously approved Bell 206B helicopters.

5. FAILURE CONDITIONS

Hydraulic, electric and engine failures were simulated and no problems were noted.

Results - Satisfactory

6. EQUIPMENT

a. Independently Powered Attitude Indicator

The Iowa Public Service Company's 206B, N661PS, is equipped with an independently powered attitude indicator. The installation was functionally checked several times.

Results - Satisfactory

b. Protected Pitot-Static System

The Bell 206B, N661PS, has a heated pitot system and an alternate static system. The alternate static system was functionally checked.

Results - Satisfactory

c. Required Instruments for Instrument Flight

The Iowa Public Service Company's 206B has an excellent instrument panel layout and is very well equipped for instrument flight. The installed equipment includes:

Primary and standby attitude indicators
Dual COMM/NAV
ADF
DME
Transponder
Encoding Altimeter
SFENA Flight Assist Control System (STC SH209WE)
SFENA FCS-200 Cyclic, FCS-100 YAW, and
TDS-200 (Trim Damper) Flight Control System.
R-NAV Collins ANS-531 approved for IFR
Enroute (Prior Field Approval N629V, 3/16/78
Marker Beacon (3-light)

In view of the excellent panel layout and the installed equipment, it is recommended that the flight crew for limited IFR operation be a single pilot who holds at least a commercial pilot's certificate with a rotorcraft rating and a helicopter instrument rating.

The Rotorcraft Flight Manual Supplement was signed by Mr. R. Parduhn, Central Region Flight Test Pilot on December 19, 1979.

Conclusion: The Iowa Public Service Company's Bell 206B helicopter meets the requirements of SFAR 29-2 for single-pilot operation.

Recommendation: Recommend approval of the Iowa Public Service Company's Bell 206B helicopter.

J. J. SHAPLEY

Enclosure

Iowa Public Service Company
P. O. Box 778
Sioux City, Iowa 51102

BELL 206B
FLIGHT MANUAL SUPPLEMENT

FOR

LIMITED IFR OPERATIONS

FOR

SN 2734
N 661PS

This supplement shall be attached to the Bell Helicopter Company Model 206B Flight Manual Dated 1 July 1977

The information contained herein supplements the information of the Basic Flight Manual. For limitations, procedures and performance data not contained in this supplement, consult the Basic Flight Manual.

FAA Approved: A.R. Pauduhn, Jr.
FOR Chief, Engineering & Manufacturing
District Office
Federal Aviation Administration
Department of Transportation
Control Region, Wichita, Kansas

Date: 19 December 1979

Enclosure 1

Iowa Public Service Company
P. O. Box 778
Sioux City, Iowa 51102

MANDATORY COMPLIANCE WITH THE OPERATING LIMITATIONS IN SECTION 1 OF THIS SUPPLEMENT IS REQUIRED BY LAW.

THIS HELICOPTER IS APPROVED FOR DAY AND NIGHT VFR AND IFR IN ACCORDANCE WITH THE SFAR 29-2, IN NON-ICING CONDITIONS.

AIRSPEED LIMITATIONS

V_{mini} - 60 KTS (minimum Airspeed for instrument flight)
V_{nei} - 120 KTS (never exceed speed for instrument)
V_{yi} - 90 KTS (climb speed instrument)

ALTITUDE LIMITATIONS

Maximum Operating - 10,000 feet

CENTER OF GRAVITY LIMITS

See supplement page 3

FLIGHT CREW FOR LIMITED IFR OPERATION

The minimum crew will be a single pilot who holds at least a commercial pilot's certificate with a rotorcraft helicopter rating and an instrument rating.

FORCE TRIM

Force trim must be on all IFR operations.

STANDBY ALTITUDE INDICATOR

The standby altitude indicator shall be on prior to IFR operations.

FAA Approved: 19 December 1979

NOTICE

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8710.3

9/26/79

Cancellation
Date: 9/1/80

SUBJ: APPROVAL PROCEDURES FOR OPERATIONS UNDER SPECIAL FEDERAL AVIATION REGULATION (SFAR) NO. 29-2, EFFECTIVE JANUARY 3, 1979 (RIS: FS 8710-2)

1. PURPOSE. This notice provides guidance to field personnel for approving operations under Special Federal Aviation Regulation (SFAR) No. 29-2.

2. DISTRIBUTION. This notice is distributed to the Offices of Flight Operations and Airworthiness in Washington headquarters to the branch level; Flight Standards offices in the regions and the Aeronautical Center to the branch level; and to all Flight Standards and International Aviation field offices.

3. CANCELLATION. Notice 8710.2, Approval Procedures for Operations Under Special Federal Aviation Regulation (SFAR) No. 29-2, Effective January 3, 1979 (RIS: FS 8710-2), dated 7/12/79, is canceled.

4. BACKGROUND. SFAR No. 29-2 became effective on January 3, 1979. SFAR No. 29 was originally promulgated in 1975 to enable the FAA to gain IFR experience with helicopters not meeting the then-existing IFR flight-handling qualities criteria. SFAR No. 29 expired on December 31, 1975, but was extended by SFAR No. 29-1 to December 31, 1978. SFAR No. 29-2 extends the expiration date to December 31, 1980, in order to provide time for further study to determine whether the airworthiness requirements should be revised. Only two operators applied and were approved to operate under SFAR No. 29 and SFAR No. 29-1. Only three additional operators have applied and been approved to operate under SFAR No. 29-2.

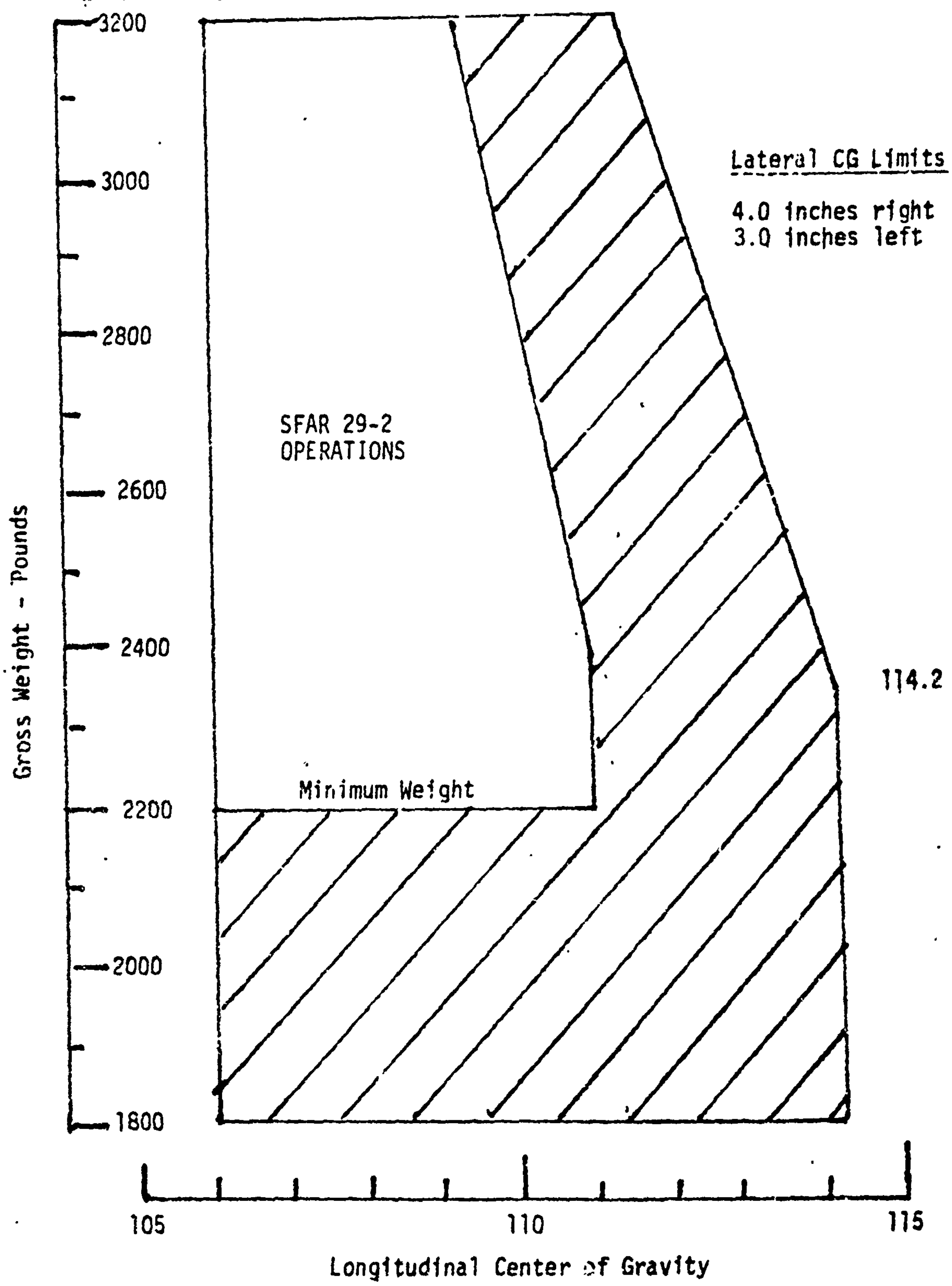
5. FORM AND REPORTS. Appendix 2 contains a questionnaire (FAA Form 8710-8) which is to be used in recording and transmitting the data collected during the study. Additional forms are available from AFO-824 or local reproduction is authorized.

6. APPLICABILITY. This notice applies to the implementation of SFAR No. 29-2 which allows for limited operations under instrument flight rules (IFR) of certain helicopters that are limited by their type certificates to operations under visual flight rules (VFR). Additionally, the appropriate provisions of FAR Part 135 are applicable to operations conducted under that part by operators authorized to conduct operations under SFAR No. 29-2. Approval guidelines contained in AFS-800's letter dated December 28, 1978; AFS-1's letter dated January 11, 1979; and AFS-100's letter dated February 6, 1979; are canceled.

Distribution: A-W(FO/WS)-3; A-X(FS)-3; AFO-500 (20); A-FFS-0(STD); A-FIA-0(STD)

Initiated By: AFO-824

Iowa Public Service Company
P. O. Box 778
Sioux City, Iowa 51102



FAA Approved: 19 December 1979

* (2) Properly conduct air-ground communications and comply with complex air traffic control instructions.

Each person taking the autopilot/SAS check must show that while using the autopilot/SAS the aircraft is operated as proficiently as it would be if a second in command were present to handle air-ground communications and copy air traffic instructions. This demonstration must be accomplished each 6 calendar months. Initial and recurrent instrument competency checks conducted by FAA inspectors or designated company check pilots under Part 135 are acceptable to meet the instrument competency check requirements of this paragraph. The instrument competency checks, for those operations not conducted under Part 135, must be conducted by FAA inspectors. *

h. In accordance with SFAR No. 29-2, a copy of the FAA approval and a copy of the SFAR itself must be set forth as a supplement to the rotorcraft flight manual. In addition, the conditions and limitations deemed necessary for safe operation of the rotorcraft in IFR operation must be incorporated in the operating limitations section of the rotorcraft flight manual. This will require involvement of regional engineering and manufacturing personnel.

(1) Accordingly, a joint operations/engineering evaluation of the proposed flight envelope and equipment installation will be conducted in order to comply with paragraph 2c of the SFAR. The evaluation will include as a minimum:

(a) A qualitative evaluation of the proposed flight envelope (center of gravity, airspeed, altitude, rate of climb/descent, gross weight). The aircraft shall be free of rapid or excessive divergence within the flight envelope.

(b) Night flight.

(c) Flight in actual instrument meteorological conditions (IMC).

(d) Flight in turbulence.

(e) Failure conditions (hydraulic, electric, engine).

(f) Preparation of a Type Inspection Report to document the results of the evaluation.

(2) Equipment must include:

(a) An independently-powered standby attitude indicator. The independent power source may be a backup electrical system, standby battery, vacuum, or bleed air source. (Attitude indication must be provided to make a safe landing from maximum IFR operational altitude after a total systems failure.)

7. IMPLEMENTATION.

a. An application (letter) for approval under SFAR No. 29-2 should be submitted to the GADO/FSDO having jurisdiction over the area in which the applicant's principal business office is located. Present operators that have been approved need not reapply. However, new letters of approval may be issued, when necessary, to authorize the provisions of this notice.

b. The application must identify each rotorcraft to be used under the approval by make, model, and serial number. Each rotorcraft must be type certificated under FAR Part 27 or FAR Part 29 and must meet all the instrument and equipment requirements of FAR Part 91, Section 91.33.

c. Except as provided in paragraph d, the minimum flightcrew must include a pilot in command (PIC) and a second in command (SIC). A complete set of flight controls must be available at each pilot station. Both pilots must hold rotorcraft-helicopter and instrument-helicopter ratings.

d. Single pilot operations may be approved for those aircraft type certificated for a crew of one under VFR conditions if the installations include compensating features, such as a stability augmentation system (SAS) and/or autopilot. Such an approval will require only one set of flight controls.

e. Operations may be approved for the purpose of instrument flight instruction with PIC's that are appropriately rated to instruct instruments in helicopters, and an SIC that holds at least a private pilot certificate with a rotorcraft-helicopter rating. Passenger carrying is prohibited during instructional operations; however, a third crewmember undergoing instrument training may be carried as an observer. A complete set of flight controls must be available at each pilot station.

f. Each applicant will be required to establish a pilot competency program. It must ensure that each pilot has sufficient proficiency to satisfactorily complete the initial instrument competency check specified in paragraph g. Additionally, it must ensure that each pilot understands the provisions and limitations of: SFAR No. 29-2, the flight manual supplement, the letter of authorization, and the data and procedures needed to complete the SFAR No. 29-2 Questionnaire.

g. Each PIC will be required to complete an initial instrument competency check in each type rotorcraft authorized, and subsequent 6-month instrument checks in at least one of the rotorcraft in which he is authorized to operate under the SFAR. The PIC using compensating features, such as a SAS or auto- *pilot in lieu of an SIC, must show, during the required instrument check, that he/she is able (without a second in command) both with and without using the autopilot/SAS to:

(1) Conduct instrument operations competently; and *

(b) A heated pitot tube and static port, or equivalent means of preventing airspeed and static system malfunction due to icing.

(c) The required instruments per FAR 27.771 and 27.1321, or FAR 29.771 and 29.1321, as appropriate. (For dual pilot approvals, the required instruments for the second pilot shall be determined during the certification program.)

(d) The pilot in command must use a boom mike. The transmitter must be capable of being activated through a device located on the flight controls.

(e) For single pilot operation, a stability augmentation system and/or autopilot system that is capable of maintaining flight of the helicopter about the three axes is required. * A two-axis (pitch and roll) SAS may be approved under the requirement provided the engineering evaluation conducted under paragraph 7h(1) of this notice establishes that the lateral-directional stability characteristics of the helicopter with SAS and the associated workload are satisfactory for single pilot IFR operation. * The application must contain the make, model, and registration number of each helicopter in which a SAS and/or autopilot is installed, and the make and model of each SAS and/or autopilot installed.

(f) For night IFR operations, a standby power source for lighting the flight instruments and required radio communication/navigation equipment in the event of electrical system malfunction.

i. It should be noted that SFAR No. 29-2, paragraph (c)4, contains a relaxatory provision for fuel required for flight in IFR conditions, which must be specifically addressed in the Letter of Approval, if it is to be applied.

j. In order to avoid delays in the approval process, it is essential that direct contact be established with the type certificate-holding region, to facilitate coordination between the district office and the Engineering and Manufacturing Branch which has responsibility for the type certificate involved.

8. IFR STUDY. SFAR No. 29 was adopted as an interim measure, pending conclusion of an FAA study of IFR operations with rotorcraft, which are otherwise certificated for VFR operations only. An approval under SFAR No. 29-2 may only be issued as part of that FAA study of rotorcraft IFR operations.

9. REPORTING PROCEDURES (RIS: FS 8710-2).

a. District office personnel involved in IFR helicopter approvals should carefully review the contents of SFAR No. 29-2.

b. The enclosed questionnaire (Appendix 2) shall be used by those district office personnel involved with SFAR No. 29-2 approvals. Information

provided in response to the questionnaire should be in precise terms and descriptions in full detail. Response should be provided from both district office and operator personnel. The district office will complete the questionnaire (in duplicate), attach comments and/or observations related to their surveillance of the operation, and forward it through the regional office to AWS-100, with a copy directed to AFO-800. A report (questionnaire) on each operator (including inactive operators) should be forwarded each 90 days. Regional comments should be attached as appropriate.

c. Copies of the letter of approval and the supplement to the flight manual will be forwarded to AWS-100 and AFO-800.

d. District office personnel will provide immediate notification to AWS-100 and AFO-800 of any reported "hazardous" flight operations.

e. Questions related to SFAR No. 29-2 approvals should be directed to AFO-824, (202) 426-8196; or AWS-160, (202) 426-8323.

Kenneth S. Hunt

KENNETH S. HUNT
Director of Flight Operations

LETTER OF APPROVAL (SAMPLE)

XYZ Construction, Inc.
1234 Any Stree.
USA

Gentlemen:

XYZ Construction, Inc., is authorized by this approval to conduct helicopter operations under instrument flight rules (IFR) in accordance with Special Federal Aviation Regulation No. 29 (SFAR No. 29-2), and the conditions and limitations contained herein as part of the Federal Aviation Administration's (FAA) study of limited IFR helicopter operations. A copy of this approval and a copy of SFAR No. 29-2 will be set forth as a supplement to the rotorcraft flight manual, along with those operating limitations considered necessary for the safe operation of the rotorcraft in IFR operations, as incorporated in the operating limitations section. This letter of approval, the operating limitations, and a copy of SFAR No. 29-2 constitute a supplemental type certificate.

CONDITIONS AND LIMITATIONS:

1. Only those helicopters listed, as follows, will be operated under this approval: (e.g., Bell Model 206, Serial No. 12345, Registration No. N54321).

2. The minimum flightcrew must include a pilot in command and a second in command. For single pilot operation an approved and operable stability augmentation system/autopilot can be used in lieu of a second in command.

a. SAS/autopilot make (XYZ) and model (123).

3. Each pilot crewmember must hold a rotorcraft-helicopter rating and an instrument helicopter rating (except as specified in paragraph 4).

4. For the purpose of instrument instruction, each pilot in command must hold flight instructor certificate with rotorcraft-helicopter and instrument-helicopter ratings. The second in command must hold a pilot's certificate with a rotorcraft-helicopter rating. The second pilot need not comply with paragraph 5 of this letter while undergoing a formal training program leading toward an instrument-helicopter rating.

2

*5. Each PIC authorized single pilot approval must have satisfactorily accomplished an instrument competency check utilizing a SAS or autopilot in lieu of a second in command within the preceding 6 calendar months.

6. Each pilot crewmember must have in their personal possession a letter of competency issued by an FAA inspector or authorized check pilot. Each pilot will conduct only those types of instrument approaches authorized by the letter of competency. *

7. Each helicopter operated under instrument flight rules shall meet the instrument and equipment requirements of Section 91.33 and the following additional equipment:

a. An independently-powered standby attitude indicator.

b. A heated pitot tube and static port, or equivalent means of preventing airspeed and static system malfunction due to icing.

c. The required instruments per FAR 27.771 and 27.1321, or FAR 29.771 and 29.1321, as appropriate.

d. The pilot in command must use a boom mike. The transmitter must be capable of being activated through a device located on the flight controls.

These instruments and equipment must be operable. A complete set of flight controls shall be installed and operable at each pilot station, except that single pilot approval will require a set of flight controls only at the PIC station.

8. In accordance with paragraph (c)(4), SFAR No. 29-2, the fuel reserve required by FAR 91.23(a)(3) may be reduced to 30 minutes.

9. XYZ Construction, Inc., will provide immediate district office notification of any "hazardous" flight conditions encountered.

This approval terminates on December 31, 1980, unless sooner surrendered, suspended, or revoked.

JOHN F. BROWN
Chief, General Aviation District Office

SFAR NO. 29-2 QUESTIONNAIRE

1. Aircraft make and model ______________________

2. Type of operation (air taxi, executive, etc.) ______________

3. Dates covered: From ______________ To ______________

4. Hours flown in IMC during this period ______________

5. Did the aircraft exhibit any undesirable flight characteristics in IMC: ______________ Date ______________

If yes:
   a. C.G.__________ G.W.__________
   b. Airspeed__________
   c. Altitude__________
   d. Rate climb/descent__________
   e. Turbulence__________
   f. SAS on/off__________
   g. Other pertinent factors__________

____

____

____

Each undesirable flight characteristic experienced should be reported (attach separate reports as necessary).

6. Were control feel and instrument indications adequate for IFR flight? If not, or if you found either lacking in some area, please elaborate, describing stability augmentation system (SAS) or autopilot modes, if applicable.

7. Were any system failures encountered which resulted in undesirable situations for instrument fight? ______________ If so, please describe.

8. Were there any undesirable conditions associated with instrument flight at night or in turbulence? ____________________ If so, please describe.

9. Were there any inadvertent icing encounters? ____________ If so, please describe extent of icing and effects on flight characteristics and system operations.

10. Please describe your assessment of crew workload associated with helicopter IFR workload. Workload is considered to be the total physical and mental effort required to fly the helicopter, navigate, communicate with ATC, etc., for a substantial period of time. Describe for pilot and copilot, and elaborate on airspace congestion, maximum flight time or helicopter endurance.

11. Were there any undersirable situations associated with cockpit instrumentation or displays in IFR flight? _______ If yes, please describe.

12. Describe any problems associated with ATC system/helicopter interface.

13. Do you have any recommendations relative to operations under SFAR 29-2?

14. Operator ________________________________
Operator personnel involved ________________________
Operator phone number (   ) ______________
District offi.e personnel involved ____________________

FAA Form 8710-8 (7-79)

Local Reproduction Au.norized

AGENDA ITEM 1.4
OPTIONAL EQUIPMENT POLICY

PROBLEM:

The questions: whether existing rules provide a legal basis for evaluating optional equipment and what is the FAA responsibility for approving optional equipment? (Reference 1977 Agenda Item 28).

STATUS:

AWS-130 has not generated any draft AC to date, however, until such material is generated, the discussion provided in past workshop minutes should be sufficient. The Order 8110.10C distribution to DER's will be accomplished as a result of distributing the minutes of this meeting.

AWS-130 received from AWE-130 the Draft AC.

ACTION:

AWS-130 will coordinate an AC for optional equipment approval guidance with AFO-800. AWE-130 would draft an Advisory Circular by 12/79, and coordinate with the regions. AWE-130 would provide to AWS-130 (by 1/80) the results of the AC coordination. AWS-130 to initiate steps to publish AC.

DISCUSSION:

Reviewed RTCA & AGC letter conerning "Optional Non-Required No Hazard Approvals". Reviewed briefing memo to RTCA.

An Advisory Circular was to be prepared by AWE-130.

CONCLUSION:

AWE-130 is to develop a draft AC and provide to AWS-130 by 1/80. AWS-130 would initiate the final AC for publishing.

BRIEFING MEMORANDUM

by R. J. HUHN
AWS-131
8-13-79

SUBJECT: Required, Non-required Optional Functions/Equipment.

REFERENCE: FAR 23, 25, 27, 29 - (FAR 23, 1301, 1309; 25.1301, 1309; 27.1301, 1309; 29.1301, 1309) AGC-20 letter dated 19 June 1972, Systems/Flight Test workshops minutes of item 28 of 1977; RTCA MOPS guideline; FAR 91, 121.

ISSUE: What is and is not required or non-required (optional) functions/equipment, has not been fully understood within FAA or the aviation industry. How these terms are related to "type certification of an aircraft and "operations certification" or "approval to operate the aircraft in the national airspace" also has been misunderstood.

DISCUSSION: For example, an altimeter is required equipment (instrument) for aircraft "type certification." In other words, for an airframe manufacturer to receive a type certificate for his aircraft, he must have a type design that specifies an altimeter that has an FAA approved installation. The altimeter is also a required instrument in the operating rules. FAR 23.1303(b); 25.1303(b)(2). FAR 91.33(b)(2) are the referenced rules for fixed wing light aircraft and transport aircraft.

A communications transceiver is not required equipment for FAR 23 type certification, but it is required equipment for transport aircraft (FAR 25.1307(d)) type certification. The FAR 91 operating rules require the Comm equipment if the aircraft is to be operated in the National Air Space when communications equipment is required (FAR 91.33(d)(2)-IFR)(FAR 91.87-airport control traffic area)(FAR 91.90-terminal control area). In essence, the non-required communications transceiver on Part 23 aircraft is now required equipment in certain operating conditions of the aircraft.

A Part 23 airframe manufacturer may wish to have his aircraft type certificated for Instrument Flight (IFR) in order to list in Airplane Flight manual, the kinds of operation to which the aircraft is limited (FAR 23.1525) e.g., VFR, IFR, icing, etc.. As a result of the basis for type certification the non-required communications transceiver becomes required equipment for type certification for his aircraft.

An Airframe manufacturer looks upon non-required equipment as not required for VFR approval and thus are optional equipment the customer may wish to purchase, to increase the utility of his aircraft. Unfortunately, this non-required equipment if utilized in operating conditions requiring them, it thus changes their non-required or optional status to a "required" status. This situation also applies to required or non-required equipment that have optional functions/equipment. When the optional function/equipment is utilized in an operating condition that requires their use, they become required equipment.

The operating rules in most instances do not specify the minimum performance for all required equipment under the rules. In those cases, the general requirements of FAR 23.1301, 1309; 25.1301,1309 are utilized. These general requirements have been found by the FAA general counsel to be the minimum required for FAA approval which is summarized as; perform its intended function, operate in the environment in which it is installed, and not constitute a hazard to other equipment or the aircraft and the National Air Space. As a result, it is common practice to utilize Technical Standard Orders as an evaluation basis for required and non-required (optional) equipment. However, only those TSO performance aspects that would be pertinent to that aircraft are applied.

There are some installations in which non-required/optional equipment was not intended to meet a type certification requirement, but was installed as an option at the request of the customer. Anti-icing or de-icing equipment has been installed without credit for operating conditions normally associated for such equipment. Unfortunately, the minimum performance capability of the equipment was not always established which has resulted in some operators over estimating the capability of their optional equipment to anti-ice or de-ice their aircraft. For this equipment, airplane flight manual limitations should be established for the equipment under 23 and 25.1301.

STATUS: RTCA is currently establishing a "minimum operational performance specification" (MOPS) for airborne approach (weather) radar. Their MOPS guidance document and the draft radar MOPS is unclear to what is required and optional equipment. The FAA AEM representative to RTCA proposes to send a letter to RTCA providing some recommended preamble to both documents in order to help guide this and future MOPS committee members. AEM-100 has drafted a letter which has its problem in conveying the total issue.

An Advisory Circular regarding general counsel's letter was

proposed at the 1977 Systems/Flight Test workshop. This proposal has not been accomplished.

RECOMMENDATION:

1. An FAA draft order should be coordinated with regional offices for comment to

   a. establish the status of the terms required, non-required optional functions/equipment
   b. establish the certification guidelines for paragraph 1.a. items
   c. clarify implementation of general counsel's letter regarding optional funtions/equipment.

2. Publish an Advisory Circular to establish a definition of terms and the FAA intended handling in keeping with general counsel's guidance.

11/7/79

DRAFT ADVISORY CIRCULAR

SUBJECT: Optional Equipment Installation Approvals

1. PURPOSE: This advisory circular presents acceptable means, but not the only means, of showing compliance with applicable airworthiness regulations in connection with the certification of equipment installations not specifically required by the Federal Aviation Regulations.

2. REFERENCES: Federal Aviation Regulations, Parts 23, 25, 27 and 29, "Subpart F - Equipment" for each part.

3. DEFINITION: For the purpose of this advisory circular, the term "Optional Equipment" is defined as any system, equipment or installation which is not specifically required by any Federal Aviation Regulations. Existing FARs do not refer to or define "optional equipment" as a meaningful term.

4. BACKGROUND: Questions have been raised relative to optional equipment and legal opinions have been developed in the Federal Aviation Administration in response to those questions.

It is now considered appropriate to state those questions and summarize answers as useful guidance in reaching mutually acceptable means of compliance with applicable regulations when optional equipment items are presented for certification.

5. DISCUSSION:

a. The questions presented to the legal counsel of FAA may be stated substantially as follows:

(1) Do existing regulations provide a legal basis for evaluating optional equipment?

(2) What is the FAA's responsibility for approving optional equipment?

b. Applicable regulations effective in the past, such as CAR 4b.601 and FAR 25.1301 as first recodified, referred only to "required basic equipment". This was generally construed to exclude equipment which is <u>not</u> required and, therefore, no regulatory requirements would need to be applied. That interpretation was not supported by legal counsel on the grounds that it is the responsibility of the Administrator to determine that each aircraft has no unsafe feature prior to its certification. This fundamental requirement was introduced as CAR 4b.10 effective July 20, 1950, and CAR 3, Amendment 3-7, March 5, 1952; later recodified as FAR 21.21 (b)(2), leading to evaluations referred to as "no-hazard approvals".

c. A fundamental consideration is the function provided by an item of optional equipment and the use to which it can be used by the flight crew. Where an equipment or system is a "part or appurtenance" of the aircraft, and is designed to aid and will obviously be used by the crew, the statutorily required tests and findings must necessarily account for that equipment whether or not it is characterized as "optional".

6. <u>ACCEPTABLE MEANS OF COMPLIANCE</u>:

a. Equipment, systems and installations, whether they are "required" or not under the regulations in the certification basis being applied, should

be shown to perform their intended functions; but not necessarily how well or to a specific performance standard (such as accuracy).

b. The extent to which equipment must be tested or evaluated, in order that the Administrator may make the necessary finding with respect to the whole aircraft, is a technical determination within the engineering and operational expertise of the Administrator.

c. The effect that the optional equipment can have on the aircraft and other items of equipment should be evaluated, both when the optional equipment is functioning properly and following failure conditions which can be reasonably expected to occur.

d. Evaluation of optional equipment which provides information to the flight crew which could be misleading or could, if used by the crew, result in an unsafe condition, should consider procedures and limitations needed for the safe operation of such optional equipment.

7. AIRPLANE/ROTORCRAFT FLIGHT MANUAL MATERIAL: The flight manual material and placards, when appropriate, should provide information to the flight crew as needed for the safe operation of the optional equipment, and to minimize the probability of hazards associated with its functioning and its malfunctioning.

EvMor[illegible]:AWE-132:x6364:11/7/79

cc:

File:

2.0 GUIDANCE

AGENDA ITEM 2.1
FAR §§ 23.1309, 25.1309 AC GUIDANCE
SYSTEMS DESIGN ANALYSIS

PROBLEM:

The application of FAR § 23 and 25.1309/Systems Design Analysis Advisory Circular Guidance (Reference 1977 Agenda Items 20 & 21).

STATUS:

1) AC § 23.1309 draft has been coordinated within AWS-100 as of June 1978 and has been coordinated with industry.

2) AC § 25.1309 draft is in coordination with AGC, AVS, and AED.

3) AC § 25.901 guidance by AWS-140 is in draft only. Currently shelved until further notice.

ACTION:

AWS-130 will provide status at workshop.

DISCUSSION:

AC 23.1309 comments are being reviewed by AWS-130. Due to strong comments by GAMA, a redraft will be developed by AWS-130.

Personal briefings by AWS-130 to AVS & AED is the final clearance work necessary for AC 25.1309 in order to publish by the end of 1979. It was recommended that AWS-130 consider Part 27 & 29 for .1309 applicability.

Draft AC 25.901 provided to this workshop for information only, by AWS-140. Several areas requiring revision are thought necessary by AWS-140, prior to circulation for review and comments.

CONCLUSION:

AWS-130 will prepare a draft of 23.1309 by 3/80.

AC 25.1309 to be written/published by December 1979.

AC 25.901 redraft is not anticipated in the near future by AWS-140.

ORDER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8110.

DRAFT

SUBJ: GUIDANCE INFORMATION CONCERNING THE APPLICATION OF FAILURE ANALYSIS TO POWERPLANT AND APU INSTALLATIONS

PURPOSE: This order provides guidance information on FAR Sections 25.901, and 25.1309

DISTRIBUTION: This order is distributed to all Flight Standards Offices in Washington, to the Branch level; and to all Flight Standards Office in the regions, to the Section level.

BACKGROUND: There have been questions within the Federal Aviation Administration (FAA) and industry concerning the application of the concept of system failure analysis of FAR 25.1309 and FAR 25.901(c) to the powerplant and APU installations.

Before the Airworthiness Review of December 1974, FAR 25.901(c) stated that the powerplant installation must comply with the failure analysis of FAR 25.1309.

During the Airworthiness Review a proposal to delete the reference to .1309 in FAR 25.901(c) was discussed. Instead of the reference to .1309, more explicit wording was used to describe the failure analysis requirement. While industry representatives pointed out that they did not oppose a numerical failure analysis as another useful tool in the design evaluation process, they did express their concern about the lack of availability of data to make such an analysis valid. The industry representatives at the Airworthiness Review also objected to the increased economic burden imposed on them due to the increased costs to make this type of analysis during a certification program.

In rebuttal, the FAA stated their position that the numerical failure analysis is a useful tool that can supplement other types of analysis and engineering judgement in design evaluations.

The proposal to replace the reference to .1309 in FAR 25.901(c) with a specific requirement for a failure analysis of the propulsion installation has been adopted.

The intent of this order is to explain the propulsion responsibilities in applying the amended FAR 25.901(c).

Distribution: Initiated By:

4. <u>EXPLANATION OF CHANGE</u>: Amendment No. 4: Powerplant Amendments - Airworthiness Review Program dated March 17, 1977 deleted the reference to §25.1309 in §25.901(c) and replaced it with a specific requirement that no single failure or combination of failures in each powerplant or APU installation can jeopardize safe operation of the airplane. There is also a provision that structural elements need not be considered in this analysis if the probability of such a failure is extremely remote.

5. <u>ACTION</u>: Even though §25.901(c) has been amended to remove the reference to §25.1309, the revised wording still requires some kind of analysis of the powerplant systems and powerplant and APU installations to determine that no single failure or combination of failures can jeopardize continued safe operation of the airplane. The amended §25.901(c) does not specify a numerical analysis to make this determination, although it could be a very useful tool to supplement a fault analysis and engineering judgement in obtaining compliance with the rule.

The powerplant rules have been developed over the years with the intent to prevent catastrophic failures through specific design requirements. §25.933, Reversing Systems; §25.953, Fuel System Independence; §25.937, Turbopropeller Drag Limiting Provisions; and §25.1141, Powerplant Controls are typical examples of this approach.

In addition, redundancy of critical powerplant system components, such as standby fuel pumps have been incorporated into the powerplant requirements, together with isolation of powerplant systems, to prevent a catastrophic consequence from the failure of a critical component in the powerplant installation.

However, with the development of more sophisticated powerplant installations with [illegible] engine fuel control systems integrated with on-board computers, a more thorough system analysis of the powerplant installation is advisable to more readily identify failures that could have a catastrophic consequence.

Compliance with §25.901(c) can be obtained through a rigorous analysis of the various systems of the APU and powerplant installation to ascertain whether the malfunction or failure or combination of failures of critical components in the powerplant systems can lead to an unsafe condition. The design analysis can be a combination of numerical analysis, fault analysis and engineering judgement since these techniques supplement each other in making a determination of the airworthiness of systems designs.

One of the problems that may be encountered in an analysis is to establish the extent of in-depth evaluation of systems and subsystem components. Sound engineering judgement should be used in determining whether a particular component is "critical", that is, whether its malfunction or failure has significant impact on the subsystem or system so that it can lead to a unsafe condition and jeopardize the continued safe operation of the airplane.

3.0 STANDARDS/PROCEDURES

AGENDA ITEM 3.1
PERIODIC TSO REVIEW
AND UPDATE

PROBLEM.

Most TSO's are technically obsolete and should be updated (Reference 1977 Agenda Item 1).

STATUS.

The DOT/FAA project priority system has placed TSO's at the bottom of the list.

ACTION:

AWS-130's current approach is to -

1) relocate the substance of Subpart A of Part 37 to Part 21,

2) develop individual documents for each of the performance standards in Subpart B of Part 37,

3) adopt a new public procedure for revising and issuing new (Industry/FAA) performance standards, and

4) revoke Part 37.

DISCUSSION:

NPRM 79-15 TSO revision program was reviewed in detail. Regional review and support urgently needed for identification of proposed program weakness. Special regional team may be established to assist in package finalization.

CONCLUSION:

NPRM issued October 1, 1979, with comments due by December 3, 1979. AWS-130 will send a copy to all attendees by November 1979. Copies made available to RTCA, SAE, and DER's.

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 11, 21, and 37

[Docket No. 19589, Notice No. 79-15]

Technical Standard Orders (TSO'S) Revision Program

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rule making.

SUMMARY: This notice announces the Technical Standard Orders Revision Program. The objective of the Program is to adopt a new public procedure to expedite the issuance of standards for specified materials, parts, and appliances used on civil aircraft. In accordance with Executive Order 12044, these new procedures will result in less burdensome requirements which will expedite TSO issuance, and will result in the substantial reduction of regulatory material. The proposed changes are necessary to stay current with the continuing growth and technological advances in the aeronautical state-of-the-art.

DATES: Comments must be received on or before December 3, 1979.

ADDRESS: Send all comments on the proposal in duplicate to: Federal Aviation Administration, Attn: Rules Docket (AGC-24) Docket No. 19589, 800 Independence Ave., SW., Washington, D.C. 20591

FOR FURTHER INFORMATION CONTACT: Mr. Adolfo O. Astoraga, Systems Branch (AWS-130), Aircraft Engineering Division, Office of Airworthiness, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591: Telephone (202) 426-8395.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of the proposed rule by submitting such written data, views, or arguments as they may desire. Comments relating to any significant environmental or economic impact that might result because of the adoption of these proposals may also be submitted. Communications should identify the regulatory docket or notice number and be submitted in duplicate to the address specified above. All communications received on or before the closing date for comments specified above will be considered by the Administrator before taking action on the proposed rule. The proposals contained in this notice may be changed in the light of comments received. All comments submitted will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarizing each FAA public contact concerned with the substance of these proposals will be filed in the Rules Docket.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must submit with those comments a self-addressed, stamped postcard on which the following statement is made. "Comments to Docket Number 19589." The postcard will be date/time stamped and returned to the commenter.

Additional Copies of Notice

Any person may obtain a copt of this notice of proposed rule making (NPRM) by submitting a request to: Federal Aviation Administration, Office of Public Affairs, Attention: Public Information Center, APA-430, 800 Independence Ave., SW., Washington, D.C. 20591 Telephone: (202) 426-8058

Each communication must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future NPRM's should also request a copy of Advisory Circular No. 11-2 which describes the application procedure.

Background

Whenever a material, part, process, or appliance is to be used on an aircraft, it must be approved under the Federal Aviation Regulations before it can be utilized. Such approval can be obtained in any one of the following ways:

(1) Under a Parts Manufacturer Approval issued under 14 CFR 21.303;

(2) In conjunction with type certification procedures for a product;

(3) Under a Technical Standard Order (TSO) issued under 14 CFR Part 37 or;

(4) In any other manner approved by the Administrator.

One of the several methods of obtaining approval is under a TSO which contains minimum performance and quality control standards for specified materials, parts, or appliances (articles). The standards for each TSO are those the Administrator finds necessary to ensure that the articles concerned will operate satisfactorily. If a part to be used on a civil aircraft has been manufactured under a TSO authorization, the part is an approved part for the purpose of meeting the Federal Aviation Regulations. Since compliance with a TSO authorization is only one of the suggested methods of obtaining approvals, the standards contained therein are not mandatory but are only an optional way of obtaining approval for a particular part. For example, a manufacturer can obtain approval to deviate from a particular TSO if it shows that the design features provide an equivalent level of safety. Therefore, the standards in any given TSO are not necessarily the only ones that must be followed in order to obtain FAA approval for use of the part.

As set forth above, TSO's are not statements of general or particular applicability designed to implement or prescribe law or policy; therefore, they do not fall within the definition of "rule" contained in the Administrative Procedure Act. As a result, there is no requirement that TSO's be published as notices of proposed rulemaking in the **Federal Register**. As explained later in this proposal, however, the FAA will provide notice in the **Federal Register** and through Advisory Circulars of all proposed and final changes to all TSO's. Currently, the FAA handles TSO's through the normal rulemaking process. However, an increase in the volume and complexity of the FAA rulemaking activities no longer makes it practical for the FAA to utilize the rulemaking process to establish voluntary TSO's.

The FAA has determined that it is appropriate, in the interest of safety, to initiate a program to adopt new public procedures to facilitate the issuance of standards for specified materials, parts, and appliances on civil aircraft.

The Technical Standard Orders Revision Program will be carried out with full opportunity for the participation of industry, other Government agencies, foreign governments, and the public.

An essential part of the revision of the Technical Standard Orders Program is an effort to simplify and standardize the requirements and rules for FAA approval for such materials, parts, and appliances for which standards have been issued. Therefore, the Administrator has decided that as a part of this effort, an NPRM will be shortly issued which will propose changes to the Parts Manufacturer Approval procedures contained in Part 21 of the Federal Aviation Regulations.

VS-79- 393-R

(As published in the Federal Register (44 F.R. 56370) on October 1, 1979)

The New Public Procedure

The FAA will continue to develop draft standards. These standards will be circulated for public comment through the use of mailing lists and an Advisory Circular which will list all current TSO's and those which it is anticipated will be amended within the succeeding 12 months. A copy of the Advisory Circular will be published in the Federal Register every 6 months. In addition, notice of proposed changes and final changes to TSO's will be contained in the summaries of petitions for exemption and rulemaking published in the Federal Register in accordance with Part 11 of this Chapter. Any individual or organization wishing to obtain copies of specific draft standards or all such standards proposed by the FAA may, upon request, be placed on a mailing list. They will then receive copies of those draft standards requested and will be given 90 days to submit comments. Although the FAA does not propose to publish these draft standards in the Federal Register the FAA would like specific comments concerning the proposed distribution system.

The FAA will then review the comments submitted and issue a final standard. Copies of the final standard will be mailed to all persons on the mailing list. Copies of all draft and final standards will also be available at FAA headquarters and at all regional offices.

As a result of these proposed changes, there will be substantial cost savings to industry and the FAA resulting from a reduction in the time-consuming paperwork and steps currently required to amend and issue TSO's. The proposed changes will also ensure that these standards reflect technological advances in the aeronautical state-of-the-art resulting in equipment with higher level of performance and reliability.

This proposal is consistent with the agency's responsibility to review the continuing need for our regulations and the need to eliminate unnecessary regulations. As such, this is in furtherance of Executive Order 12044, issued by President Carter on March 23, 1978.

Discussion of the Proposed Rule

Revoking the portions of Part 37 of the Federal Aviation Regulations, which requires that TSO's to be published as part of the regulations, removes the standards from the rulemaking process. The changes proposed herein also relocate to Part 21 of the Federal Aviation Regulations the requirements for the issue of and the general rules governing holders of TSO authorizations currently in Part 37, Subpart A. The FAA believes that republishing these requirements in Part 21 is the best method for maintaining regulatory consistency. The FAA would like comments on the placement in Part 21 of these requirements. Changes included in this proposal include:

1. Present § 11.49(b)(2) delegates authority to the Director, Flight Standards, to issue, amend, and repeal TSO's under Part 37. Since Part 37 is being revoked, the delegation is no longer needed and it is proposed to delete § 11.49(b)(2).

2. Present § 21.305(b) allows materials, parts, processes, and appliances required by the Federal Aviation Regulations to be approved under a TSO issued under Part 37. Since Part 37 is being revoked, it is proposed to revise § 21.305(b) to list the Advisory Circular which will list all current TSO's and those which it is anticipated will be amended within the succeeding 12 months, and the address where copies of the Advisory Circular may be obtained.

3. Subpart A of Part 37 contains the requirements for the issue of and the general rules governing holders of TSO authorizations. It is proposed to retain the substance of these requirements and rules and to relocate them to Part 21.

The Proposed Amendment

Accordingly, the Federal Aviation Administration proposes to amend Parts 11, 21, and 37 of the Federal Aviation Regulations (14 CFR Parts 11, 21, and 37) as follows:

PART 11—GENERAL RULE-MAKING PROCEDURES

1. By adding the word "and" following the semicolon in § 11.49(b)(1); and by revising § 11.49(b)(2) to read as follows:

§ 11.49 Adoption of final rules.

* * * * *

(b) * * *

(2) [Reserved]

* * * * *

PART 21—CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

2. By revising § 21.305(b) to read as follows:

§ 21.305 Approval of materials, parts, processes, and appliances.

* * * * *

(a) * * *

(b) Under a Technical Standard Order issued by the Administrator. Advisory Circular AC No. XX contains a list of Technical Standard Orders that may be used to obtain approval (copies of the advisory circular may be obtained from U.S. Department of Transportation, Publications Section M443.1, Washington, D.C. 20590);

* * * * *

3. By adopting a new Subpart O to read as follows:

Subpart O—Technical Standard Order Authorizations

Sec.

21.601 Applicability.
21.603 TSO marking and privileges.
21.605 Application and issue.
21.607 General rules governing holders of TSO authorizations.
21.609 Approval for deviation.
21.611 Design changes.
21.613 Recordkeeping requirements.
21.615 FAA inspection.
21.617 Reporting of failures, malfunctions and defects.
21.619 Noncompliance.
21.621 Transferability and duration.

Authority: Secs. 313(a), 601, and 603, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, and 1423; sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); 14 CFR 11.45)).

§ 21.601 Applicability.

(a) This subpart prescribes—

(1) Procedural requirements for the issue of Technical Standard Order Authorizations; and

(2) Rules governing the holders of Technical Standard Order Authorizations.

(b) For the purpose of the subpart—

(1) Technical Standard Orders (hereafter referred to in this part as "TSO's") are those issued by the Administrator containing performance standards and quality control standards for specified materials, parts, or appliances (hereafter referred to in this part as "article") used on civil aircraft.

(2) An article manufactured under a TSO authorization, or an FAA letter of acceptance as described in § 21.603(b), is an approved article for the purpose of meeting the regulations of this chapter that require the article to be approved.

(3) For the purpose of this part, a manufacturer is a person who controls the design and quality of an article produced under the TSO system (or to be produced, in the case of an application) including the parts thereof and any processes or services related thereto that are procured from an outside source.

§ 21.603 TSO marking and privileges.

(a) Except as provided in paragraph (b) of this section, no person may identify an article with a TSO marking unless that person holds a TSO authorization and the article meets applicable TSO standards.

(b) The holder of an FAA letter of acceptance of a statement of

conformance issued for an article before July 1, 1962, may continue to manufacture that article without obtaining a TSO authorization, but shall comply with the requirements of §§ 21.607 through 21.621.

(c) Notwithstanding paragraphs (a) and (b) of this section, after August 6, 1976 no person may identify or mark an article with any of the following TSO numbers:

(1) TSO–C18, –C18a, –C18b, or –C18c.

(2) TSO–C24.

(3) TSO–C33.

(4) TSO–C61 or –C61a.

§ 21.605 Application and issue.

(a) The manufacturer (or an authorized agent) must submit an application for a TSO authorization, together with the following documents, to the Chief, Engineering and Manufacturing Branch, Flight Standards Division, of the region in which the manufacturer is located (or, in the case of the Western Region, the Chief, Aircraft Engineering Division):

(1) A statement of conformance certifying that the applicant has met the requirements of this subpart and that the article concerned meets the applicable performance standards issued by the Administrator.

(2) Copies of the technical data required in the applicable performance standards issued by the Administrator, unless a lesser number of copies is authorized by the Chief, Engineering and Manufacturing Branch, in the region in which the manufacturer is located or in the case of the Western Region, the Chief, Aircraft Engineering Division.

(3) A description of his quality control system in the detail specified in § 21.143 of this chapter. In complying with this paragraph, the manfucturer may refer to current quality control data filed with the FAA as a part of a previous application. When a series of minor changes in accordance with §21.611 is anticipated, the manufacturer may set forth in its application the basic model number of the article with open brackets after it to denote that suffix change letters will be added from time to time.

(b) After receiving the application and other documents required by paragraph (a) of this section to substantiate the manufacturer's compliance with this part, and after a determination has been made of its ability to produce duplicate articles under this part, the Administrator issues a TSO authorization to the manufacturer to identify the article with the applicable TSO marking.

(c) If the application is deficient, the applicant must, when requested by the Administrator, submit any additional information necessary to show compliance with this part. If the applicant fails to submit the additional information within 30 days after the Administrator's request, the application is denied and the applicant is so notified.

(d) The Administrator issues or denies the application within 30 days after its receipt or, if additional information has been requested, within 30 days after receiving that information.

§ 21.607 General rules governing holders of TSO authorizations.

Each manufacturer of an article for which a TSO authorization has been issued under this part must—

(a) Manufacture the article in accordance with this part and the applicable requirements issued by the Administrator;

(b) Conduct all required tests and inspections, and establish and maintain a quality control system adequate to ensure that the article meets the requirements of paragraph (a) of this section and is in condition for safe operation;

(c) Prepare and maintain, for each model of each article for which a TSO authorization has been issued, a current file of complete technical data and records in accordance with § 21.613; and

(d) Permanently and legibly mark each article to which this section applies with the following information:

(1) The name and address of the manufacturer.

(2) The name, type, or model designation of the article.

(3) The nominal weight of the article, which must be within ±0.2 pound of the actual weight or ±3 percent of the actual weight, whichever is greater, except that the differences between the weight marked on the article and the actual weight of the article may not exceed ±10 pounds.

(4) The serial number or the date of manufacture of the article, or both.

(5) The applicable TSO number.

§ 21.609 Approval for deviation.

(a) Each manufacturer who requests approval to deviate from any performance standard issued by the Administrator must show that the standards from which a deviation is requested are compensated for by factors or design features providing an equivalent level of safety.

(b) The request for approval to deviate, together with all pertinent data, must be submitted to the Chief, Engineering and Manufacturing Branch, Flight Standards Division, of the region in which the manufacturer is located (or, in the case of the Western Region, the Chief Aircraft Engineering Division).

§ 21.611 Design changes.

(a) *Minor changes by the manufacturer holding the authorization.* The manufacturer of an article under an authorization issued under this part may make minor changes (any change other than a major change) without further approval by the Administrator. In this case, the changed article keeps the original model number and the manufacturer shall forward to the appropriate Chief, Engineering and Manufacturing Branch (in the case of the Western Region, the Chief, Aircraft Engineering Division), any revised data that is necessary for compliance with § 21.605(a).

(b) *Major changes by manufacturer holding the authorization.* Any design change by the manufacturer that is extensive enough to require a substantially complete investigation to determine compliance with performance standards issued by the Administrator is a major change. Before making such a change, the manufacturer must assign a new type or model designation to the article and apply for an authorization under § 21.605.

(c) Changes by person other than manufacturer. No design change by any person (other than the manufacturer who submitted the statement of conformance for the article) is eligible for approval under this part, unless the person seeking the approval is a manufacturer and applies under § 21.605(a). Persons other than a manufacturer may obtain approval for design changes under Part 43 or under the applicable airworthiness regulations.

§ 21.613 Recordkeeping requirements.

(a) *Keeping the records.* Each manufacturer holding a TSO authorization under this part shall, for each article manufactured under that authorization, keep the following records at its factory:

(1) A complete and current technical data file for each type or model article, including design drawings and specifications.

(2) Complete and current inspection records showing that all inspections and tests required to assure compliance with this part have been properly done and documented.

(b) *Retention of records.* The manufacturer shall retain the records described in paragraph (a)(1) of this section until it no longer manufactures the article concerned under this part. At that time, copies of these records shall be sent to the Administrator. The manufacturer shall retain the records

described in paragraph (a)(2) of this section for a period of at least 2 years.

§ 21.615 FAA inspection.

Upon the request of the Administrator, each manufacturer of an article under a TSO authorization shall allow the Administrator to inspect—

(a) Any article manufacturered under that authorization;

(b) The manufacturer's quality control inspections and tests;

(c) The manufacturing facilities; and

(d) The technical data files on that article.

§ 21.617 Reporting of failures, malfunctions, and defects.

(a) After January 3, 1971, except as provided in paragraph (d) of this section, each manufacturer holding a TSO authorization under this part shall report any failure, malfunction, or defect in any article manufactured by it that it determines has resulted in any of the occurrences listed in paragraph (c) of this section.

(b) After January 3, 1971, each manufacturer holding a TSO authorization under this part shall report any defect in any article manufactured by it that has left its quality control system and that it determines could result in any of the occurrences listed in paragraph (c) of this section.

(c) The following occurrences must be reported as provided in paragraphs (a) and (b) of this section:

(1) Fire caused by a system or equipment failure, malfunction, or defect.

(2) An engine exhaust system failure, malfunction, or defect which causes damage to the engine, adjacent aircraft structure, equipment, or components.

(3) The accumulation or circulation of toxic or noxious gases in the crew compartment or passenger cabin.

(4) A malfunction, failure, or defect of a propeller control system.

(5) A propeller or rotocraft hub or blade structural failure.

(6) Flammable fluid leakage in areas where an ignition source normally exists.

(7) A brake system failure caused by structural or material failure during operation.

(8) A significant aircraft primary structural defect or failure caused by any autogenous condition (fatigue, understrength, corrosion, etc.).

(9) Any abnormal vibration or buffeting caused by a structural or system malfunction, defect, or failure.

(10) An engine failure.

(11) Any structural or flight control system malfunction, defect, or failure which causes interference with normal control of the aircraft or which derogates the flying qualities.

(12) A complete loss of more than one electrical power generating system or hydraulic power system during a given operation of the aircraft.

(13) A failure or malfunction of more than one attitude, airspeed, or altitude instrument during a given operation of the aircraft.

(d) The requirements of paragraph (a) of this section do not apply to—

(1) Failures, malfunctions, and defects that the holder of a TSO authorization—

(i) Determines were caused by improper maintenance or improper usage;

(ii) Knows were reported to the FAA by another person under the Federal Aviation Regulations; or

(iii) Has already reported under the accident reporting provisions of Part 430 of the regulations of the National Transportation Safety Board.

(2) Failures, malfunctions, or defects in articles manufactured by a foreign manufacturer and exported to the United States under § 21.502 of this chapter.

(e) Each report required by this section—

(1) Shall be made to the FAA Regional Office in which the holder is located within 24 hours after the holder has determined that the failure, malfunction, or defect required to be reported has occurred, except that a report due on a Saturday or a Sunday may be delivered on the following Monday and one that is due on a holiday may be delivered on the next workday;

(2) Shall be transmitted in a manner and form acceptable to the Administrator by the most expeditious method available; and

(3) Shall include as much of the following information on the article as is available and applicable:

(i) Aircraft serial number.

(ii) Article serial number.

(iii) Article model designation.

(iv) Identification of the part, component, or system involved. The identification must include the part number.

(v) Nature of the failure, malfunction, or defect.

(f) Whenever the investigation of an accident or service difficulty report shows that an article manufactured under a TSO authorization is unsafe because of a manufacturing or design defect, the manufacturer shall, upon the request of the Administrator, report to the Administrator the results of its investigation and any action taken or proposed by the manufacturer to correct that defect. If action is required to correct the defect in existing articles, the manufacturer shall submit to the Chief, Engineering and Manufacturing Branch (in the case of the Western Region, the Chief, Aircraft Engineering Division), FAA Regional Office in the region in which it is located, the data necessary for the issue of an appropriate airworthiness directive.

§ 21.619 Noncompliance.

The Administrator may, upon notice, withdraw the TSO authorization of any manufacturer who identifies with a TSO marking an article not meeting the applicable performance standards of this part.

§ 21.621 Transferability and duration.

An authorization issued under this part is not transferable and is effective until surrendered, withdrawn, or otherwise terminated by the Administrator.

PART 37—TECHNICAL STANDARD ORDER AUTHORIZATIONS

3. By revoking Part 37 and marking it to read as follows:

PART 37—TECHNICAL STANDARD ORDER AUTHORIZATIONS [Reserved]

(Secs 313(a), 601, and 603, Federal Aviation Act of 1958, as amended (49 U S C. 1354(a), 1421, and 1423; sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); 14 CFR 11.45)).

Note.—The FAA had determined that this document involves a proposed regulation which is not considered to be significant under the procedures and criteria prescribed by Executive Order 12044 and as implemented by the Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979). A copy of the final evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Issued in Washington, D.C., on September 21, 1979.

M. C. Beard,

Director, Office of Airworthiness.

[FR Doc. 79-30293 Filed 9-28-79; 8:45 am]

BILLING CODE 4910-13-M

AGENDA ITEM 3.2
INDUSTRY DOCUMENTS IN LIEU OF TSO's

PROBLEM:

Use of the latest RTCA/SAE documents in lieu of current RTCA/TSO documents (Reference 1977 Agenda Item 1).

STATUS:

The proposed material was stopped at AVS-20 based on AGC opinion that the material could be construed to be rulemaking.

ACTION:

Deregulation of Subpart B of Part 37 will solve this.

DISCUSSION:

Draft AC based on AC 37-2 concept was cancelled by AGC (non-support).

CONCLUSION:

No further action.

AGENDA ITEM 3.3
FAR § 37, SUBPART A UPDATE

PROBLEM.

An examination of the administration of the TSO systems points out a number of deficiencies in FAR § 37 (Reference 1977 Agenda Item 4).

STATUS:

After review of ASO-213 letter and a report from AWS-103, we acknowledge:

1) Regions are administering TSO system differently from each other,

2) interpretations of major and minor changes vary within and between regions, and

3) FAR § 37 Subpart A could use improvement. AWS-512 has completed a draft revision to Subpart A.

ACTION:

NPRM to be issued in 1980.

DISCUSSION: (Ref. Agenda Item 3.1)

TSO revision program will only transfer FAR 37, Subpart A to FAR 21. A revision to Subpart A will be attempted under a revision to FAR 21.

CONCLUSION:

Draft copy to be available to regions for review and comments by 12/79 from AWS-130. Region comments due to AWS-130 by 1/80.

FAA Order 8150.1 and related AC's will be revised to resolve current regional handling difficulties after Subpart A revision has been adopted.

AGENDA ITEM 3.4
PMA FOR TSO ARTICLES

PROBLEM:

Should Parts Manufacturer Approval (PMA) be issued for TSO equipment production?

STATUS:

PMA cannot be given for TSO-approved equipment or TSO replacement and TSO modification parts. AWE-130 required, in an April 1978 correspondence to Litton, removal of PMA/TSO labels on INS equipment and requested identification of those portions of INS that were TSO'd with a TSO label and those covered by STC under PMA.

ACTION:

AWS-130 to request AFO-512 to update TSO handbook 8150.1 to cover this information to the field.

DISCUSSION:

March 1978 letter was considered to solve the problem and should be a part of these minutes. Handbook revision is expected after adoption of the revision programs (Part 37 & 21).

CONCLUSION:

Handbook materials revision will be accomplished (By AFO-512) after adoption of Part 37 & 21 revision programs.

AFS-130

MAR 1978

AFS-130

Identification of TSO Articles which are modified by persons other than the TSO manufacturer: AFS-100 letter dated November 9, 1977

Chief, Engineering and Manufacturing Division, AFS-100

All Regional Flight Standards Divisions
Attention: Chief, Engineering and Manufacturing Branch
Chief, Aircraft Engineering Division, AWE-100
Chief, Aircraft Certification Staff, AEU-100

This letter replaces the subject letter, and provides additional flexibility that is considered consistent with the intent of the FAR's.

A Technical Standard Order (TSO) authorization is issued on the basis of a statement of conformance certifying that: (1) the original manufacturer has met the requirements of Subpart A of FAR 37; and, (2) the article meets the applicable performance standards of Subpart B of the applicable TSO.

FAR 37.11(c) permits design changes to TSO articles by persons other than the manufacturer who submitted the statement of conformance. If the design changes are approved under Part 43 or under the provisions of the applicable airworthiness regulations, the following identification requirements should be applied to the altered TSO article:

The design change data should require the modifier to permanently identify the article with his name, address, means of approval of the design change (for example, STC No. ___), date of the design change approval, identification of the modifications which have been performed, and any information pertinent to operating parameters; for example, environmental categories, class, maximum range, etc.

The modifier's nameplate should be added without removing the TSO identification from the original manufacturer's nameplate if:

1) the original manufacturer has notified the FAA that the modified article continues to meet all requirements of the TSO; or,

2) the modifier certifies to the FAA, based on his tests and investigations, that the modified article continues to meet all requirements of the TSO.

If the modified article does not continue to meet the requirements of the TSO, the TSO identification on the original manufacturer's nameplate should be permanently obliterated in such a manner that it cannot be restored. Such articles would have to be approved as part of an aircraft type design when installed in the aircraft.

In addition to the identification required by the design change data, the article must also be marked in accordance with the requirements of FAR 45.15, when the modified article is produced under the provisions of FAA - PMA.

JAMES O. ROBINSON

AFS-130:RB:HWaterman:lmc:x68395:3/10/78
cc: AFS-132/130/100
mc:

File No. ____________________

AGENDA ITEM 3.4a
CHANGES TO TSO ARTICLES

PROBLEM:

Changes to TSO Articles - Minor/Major - (Reference enclosed item from AGL-213).

STATUS:

Revision of Part 37 Subpart A (37.11) is being considered in the FAR 21 revision program.

ACTION:

AWS-130 to request AFO-512 to update TSO handbook 81[illegible].1 to cover this information to the field.

DISCUSSION:

AGL-213 discussed their TSO applicant problems concerning definition of minor/major changes. AWS-130 stated Subpart A revision under FAR 21 update is to standardize minor/major definitions. Regions recommended complete review of Part 1, 21, 37, 43, 121, 127, & 135 of minor/major definitions prior to standardization. Do not disregard significance of aircraft vs parts/appliance minor/major change viewpoint. Continue regional practice in handbooks on determining whether a change is minor or major. Consider the requirement for maintenance/overhaul manual be available to applicant/public.

CONCLUSION:

AWS-130 will consider recommendations from the regions during the FAR 21 revision program (PMA NPRM).

AWS-130 to issue PMA NPRM by 1/80.

Handbook materials will be revised after adoption.

SUBJECT: Changes to TSO'd articles

BACKGROUND: Great Lakes Region has had changes to TSO'd articles classified as minor by the manufacturer when the complete design concept of the article was changed.

DISCUSSION: There are many benefits to the manufacturer by classifying a change as minor. A new authorization is not needed as with a major change, and significant savings in testing are realized. The main benefit is that the same model and part number can be retained and the article can be used as a replacement article in all aircraft on which the original article has been approved. This effectively bypasses FAA installation approval. Many manufacturers have proposed any change that does not result in a change in form, fit, or function be a minor change. The problem with this is that it allows a complete change in design philosophy to be classified as a minor change. For example, an indicator that uses a D'Arsonval meter movement as its basis of indication is to be changed (redesigned) to use a torquer type movement as its means of indication. The torquer movement has significantly different characteristics than the meter movement and as such should be completely retested as is required for a major change. However, if the manufacturer can retain the original model and part number by classifying it a minor change, he does not have to do the complete retesting and can introduce it as a replacement part for the original article without further installation approval by the FAA. This goes beyond the intent of the definition of major and minor in Part 37.

AVAILABLE OPTIONS:

1. Expand the definition in Part 37 concerning major and minor changes to clarify its meaning and eliminate major changes being classified as minor changes.

2. Revise Order 8150.1, clarifying the definitions of major and minor changes.

3. Allow things to continue as they are now.

ANALYSIS OF OPTIONS:

1. This would get the revised definition to the manufacturer and would reduce disagreements between the FAA and the manufacturer.

2. This leaves the manufacturer in the dark and continues the problem.

3. This leaves us with what we have now and is unsatisfactory.

RECOMMENDATIONS:

Revise Part 37 to clearly define major and minor changes.

AGENDA ITEM 3.5
LABELING/MARKING OF ALTERED/MODIFIED
TSO PRODUCTS

PROBLEM:

Procedures and guidance for (the above agenda item) are lacking (Reference 1977 Agenda Item 7).

STATUS:

A letter dated March 21, 1978, (Ref. AI 3.4) has been distributed to all regions. The guidance is to be incorporated into an advisory circular by AFO-512

ACTION:

The material is to be incorporated into the TSO handbook.

DISCUSSION:

AC has been drafted, reviewed by the regions, and awaiting TSO revision program adoption. Material for 8150.1 have not been drafted, pending TSO program adoption.

CONCLUSION:

AWS-130 to publish AC after TSO adoption by 3/80.

AWS-130 to transmit copy of draft AC to AFO-512.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

DATE: JAN 3 1980

IN REPLY REFER TO: AWS-130

SUBJECT: TSO Marking

FROM: Director of Airworthiness, AWS-1

TO: Regional Directors
Attn: Chief, Flight Standards Division
Chief, Aircraft Engineering Division, AWE-100
Chief, Aircraft Certification Staff, AEU-100

RCA has requested TSO authorization for a weather radar under TSO-C63b. This system, in addition to weather radar capabilities, has the capability to also display an aircraft checklist and RNAV maps. RCA has requested that the entire system be marked with TSO-C63b. In order to clarify the relationship between TSO authorization and multifunction systems, the following information is provided for your guidance.

While TSO's are minimum performance standards and numerous manufacturers build equipment that exceed these standards, the standards do provide the basic functional requirements for the particular type of equipment. Equipment that is demonstrated to exceed the TSO performance standards should continue to be marked with the [illegible]ropriate TSO marking. Components such as antennas, cables, and [illegible]vices that are required for operational performance may c[illegible] to be marked with the TSO label. However, when a manufacturer li[illegible] adds additional pieces of equipment which are connected to the TSO equipment, but are not required for the TSO equipment to function, these additional pieces of equipment should not be marked with a TSO marking. The Western Region concurs with this policy on TSO marking and has denied RCA authority to mark the other pieces of equipment (to display an aircraft check list and RNAV maps) with TSO-C63b.

RCA wrote a letter to the Western Region, subsequent to the denial, citing examples of similar approvals in other regions.

The requirements for TSO marking should be uniformly applied in all regions. We request that you review your TSO authorizations in general with specific attention to the authorizations granted under TSO-C63b.

TSO approvals issued for equipment with additional pieces of equipment which are not required or covered by the TSO should be withdrawn and reissued for the equipment covered by the TSO.

M. C. BEARD

DRAFT

AC

DATE

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

FAR GUIDANCE MATERIAL

Subject: Marking of Modified TSO Equipment

1. PURPOSE. Because specific guidance for identifying Technical Standard Orders (TSO) equipment modified by persons other than the manufacturer holding design approval is not included in the regulations, this advisory circular presents an acceptable method, but not the only method acceptable to the administrator for marking such modified TSO equipment.

2. RELATED FAR SECTIONS. Sections 21.113, 21.305, 23.1301, 25.1301, 27.1301, 29.1301, 37.7, 37.11, 45.1(b), and 45.15.

3. BACKGROUND. A TSO authorization is issued on the basis of a statement of conformance certifying that: (1) the original manufacturer has met the requirements of Subpart A of Parts 37 of the Federal Aviation Regulations and (2) the article meets the applicable performance standards of Subpart B of the applicable TSO.

FAR 37.11(c) permits design changes to TSO articles by persons other than the manufacturer who submitted the statement of conformance if the design changes are approved under Part 43 of the Federal Aviation Regulations or under the provisions of the applicable airworthiness regulations.

4. MARKING. The person, other than the manufacturer holding design approval, who modifies TSO equipment should use the following procedure to assure that such modified equipment retains enough original markings to maintain identification continuity.

a. Permanently identify the article with your company name, address, modifications performed, information pertinent to operating parameters, environmental limitations, class and environmental categories (if changed from the original), date of the design change approval, and means of approval of the design change (for example, STC, No. _______.

Initiated by:

DRAFT

b. Add the above identification and leave the original manufacturers nameplate with its TSO identification intact if any of the following conditions apply:

(1) The original manufacturer notified the FAA that the modified article continues to meet all requirements of the TSO.

(2) The original manufacturer authorized others to modify his product by a service bulletin or other suitable means.

(3) The modifier certifies to the FAA, based on his tests and investigations, that the modified article continues to meet all requirements of the TSO.

(4) The modification was accomplished under the provisions of an FAA Airworthiness Directive.

If the modified article does not continue to meet TSO requirements,

c. Add the identification in (a) above and permanently obliterate the TSO number identification on the original manufacturers nameplate in such a manner that it cannot be restored. Such articles would have to be approved as part of an aircraft type design when installed in the aircraft.

d. If the modified article is produced under provisions of FAA-PMA, mark it in accordance with the requirements of FAR §45.15. This is in addition to the identification required in (a) above.

AGENDA ITEM 3.6
STANDARDIZED TEST PROCEDURES

PROBLEM:

Consider the development of standardized test procedures to be used when the system (equipment) installation is not a first-of-a-kind-type (Reference enclosed item from AWE-130).

STATUS.

ACTION:

DISCUSSION:

AWE-130 recommended a "Systems Test Handbook" (For equipment/systems) which may include lab, ground and flight test procedures. Regional support was indicated.

CONCLUSION:

AWE-130 will compile a looseleaf package comprised of regional inputs (by 11/79) and provide to AWS-130 by 12/79.

AWS-130 to investigate the inclusion in an AC or an Appendix to 8110.4.

AWE-130

AGENDA ITEM

STANDARDIZED TEST PROCEDURES FOR TIAS

SUBJECT

Most STC projects handled by the various Regions are in essence only repeat efforts of proven system installations. Only when an equipment installation is being reviewed for the very first time will there be any fundamentally unique tests associated with the evaluation. It follows that there exists the possibility of developing standardized test procedures to be used for TIA purposes when the installation is not a first-of-a-kind type. Admittedly, there may be variations between installations, and there are differences between airplanes which may affect the installations, but it appears feasible to develop standardized test procedures which are sufficiently flexible to allow for these variances.

PROPOSAL

It is suggested that each Region develop test procedures in the area of their expertise to be used as standard TIA test methods. One Region will act as a "clearing house." All test procedures will be submitted to that Region, where a data package consisting of all test procedures will be assembled. A copy of that data package is submitted to each Region for review and comment. A committee of about 5 members is selected from FAA personnel. This committee will review comments regarding the data package and finalize its content. A copy of the finalized data package is given to each systems project engineer within FAA. These test procedures are reviewed annually and updated as required.

ANALYSIS

Such a package of standardized TIA test procedures would produce the following benefits:

1. TIA test procedures throughout the agency would be uniform. An applicant requesting approval for a certain system installation would have to subject his equipment to the same tests, no matter in what Region the application is made.

2. Valuable time and effort would be saved, since the generation of test procedures would no longer be an issue. The appropriate test procedure would be referenced in the TIA.

3. Such test procedures could serve as a training tool for personnel not familiar with certain types of equipment.

4. To be able to inform an applicant at the outset of the extent of FAA required evaluations will permit the applicant to schedule the tests early in the game. This may save time for everyone concerned.

5. Referencing a test procedure as outlined will impress upon an applicant the fact that the FAA is an effective, technically competent and well disciplined agency. Such a test procedure, if handled properly, may prove to be a good public relations tool.

AGENDA ITEM 3.7
BENCH TESTS OF ELECTRONIC
EQUIPMENT

PROBLEM:

The use of bench tests of electronic equipment to verify proper system function (Reference enclosed item from AWE-130).

STATUS

ACTION:

DISCUSSION: (Ref. Agenda Item 3.6)

Workshop attendee's discussed and agreed that these types of tests should be incorporated in the "Systems Test Handbook." General agreement that limited flight test may be necessary to verify performance not exercised in bench tests, and that bench tests may be used to validate hardware changes.

CONCLUSION:

AWE-130 will consider bench, electronic bird simulation, open/closed loop cockpit simulation, etc., test procedures/concepts to be a part of the "Systems Test Handbook."

AWE-130

AGENDA ITEM

BENCH TESTS OF ELECTRONIC EQUIPMENT

SUBJECT

Various Regions have questioned the Western Region regarding the use of bench tests to verify proper system function. From the ensuing discussions, it became evident that there exist many diverse opinions as to the value and manner of application of bench tests. A few explanatory words appear appropriate.

DISCUSSION

The complexity of modern electronic equipment together with a multitude of input, control, and output functions often render bench tests a highly suitable means to demonstrate system operation. Caution must be exercised when accepting bench test data, and several important questions should be posed before agreement is reached to accept bench test data for certification purposes.

1. Since flight test time is very costly when compared to bench test time, what functions can be evaluated by means of bench tests?

2. Are there any other advantages besides cost to employ bench tests rather than flight tests when evaluating a system parameter?

3. How flight-critical are the functions to be bench tested?

4. Are there any conditions which would affect the test results, if the system were flight tested instead of bench tested? What are these

conditions, and how critical are they? Can the effects of these conditions be predicted with reasonable accuracy?

5. If any of the inputs to the test system are computer generated, simulated or synthesized, how closely do they approximate real world conditions? What data do we have to prove that the inputs are equivalent to real world conditions?

6. What data do we have which indicates that the bench test is equivalent to or better than a flight test?

7. Are there any functions which should be bench as well as flight tested? Why?

8. What test set up is needed for the bench test?

After the above questions have been reviewed, the following procedures are suggested:

1. The applicant is requested to submit a proposal detailing the features or functions of a system which can best be demonstrated by bench test. For example, the distance to transmitter restraint of an ONS can be verified very successfully in the laboratory. The same holds true for the automatic frequency tuning of an RNav system. Sometimes, both a bench test and a flight evaluation are in order. When evaluating a VLF receiver, it becomes important to determine the receiver's capability to process both wide and narrow bank FSK and MSK.

This can easily be determined in the laboratory by generating the appropriate frequencies, examining the wide band ($\pm$50 Hz) and narrow band ($\pm$25 Hz) modulation by means of a scope and by determining the receiver's capability to process both types of modulation. However, in order to evaluate whether the system will actually track wide or narrow band modulated signals, a flight evaluation must be made.

2. The systems engineer and flight test pilot will review the applicant's bench test proposal. If there are questions or problem areas, they are discussed with the applicant, and a mutually agreeable solution is worked out.

3. The applicant submits a detailed test schedule and test procedure where the length of time for all test steps and the test equipment are listed. The purpose of this is to make sure that the test set up is adequate, and that the tests have been run by the applicant prior to FAA test verification. It will also inform FAA personnel how much time is required to witness the tests. The procedure and schedule are reviewed by the systems engineer and flight test pilot. If everything appears satisfactory, the applicant is advised to schedule the tests.

4. Both systems engineer and flight test pilot attend the bench test demonstration and verify the results. The applicant then submits a report detailing th: results of the bench tests. This report will become part of the approval package.

5. It is important to note that the flight test pilot has been included in the previous considerations. As technology advances evermore closely toward fly-by-wire techniques, the flight test pilot's input becomes increasingly more important for proper bench test evaluations.

The Western Region is very hesitant to delegate bench tests, especially when new technology or untried systems are involved. We cannot give any hard and fast rules, but we wish to alert FAA personnel to exercise caution in delegating bench tests. A bench test may be as important for an approval as a flight test, and only under very rare circumstances is a flight test delegated.

AGENDA ITEM 3.8
ACCEPTANCE STANDARDS FOR
ELECTRONIC SUPPLIES

PROBLEM:

Concern relative to acceptance standards for electronic supplies purchased from aviation wholesale dealers (Reference enclosed item from ANE-250).

STATUS:

ACTION:

DICUSSION:

The Attendee's had no recommendations as to the acceptance standards for electronic supplies. Suggested that discussions be conducted with AEA.

CONCLUSION:

AWS-343 to coordinate with Aircraft Electronics Asso. (AEA) for possible recommendations concerning adequacy of electronic supplies by 3/80.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

~~AFS-830~~
ANE-250

NEW ENGLAND REGION
12 NEW ENGLAND EXECUTIVE PARK
BURLINGTON, MASS. 01803

DATE: JUL 3 - 1979

REPLY TO ATTN OF: ANE-250 Acting

SUBJECT: 1979 Systems Workshop; Regional Avionics Inspector/Specialist Participation; AFS-800 ltr (AFS-833) of 5/25/79

FROM: Chief, Flight Standards Division, ANE-200

TO: AFS-800

The following comments are forwarded for your consideration as agenda items for the 1979 Systems Workshop:

1. Field offices are reporting that aircraft owners and operators are seeking assistance in determining the approval status of factory-installed area navigation systems.

The confusion involves type of approval authorized for RNAV Systems when there is no documentation, placard and/or flight manual included. Advisory Circular AC 90-45A speaks to both types of approval and, for a time, aircraft were being received from the factory with VFR only placards installed on RNAV cockpit instrumentation. Reportedly, aircraft are now being received with full RNAV systems installed and no manual information or placards in evidence. We further understand this implies full FAA VFR/IFR approval in a negative sense but feel it should be discussed for a more satisfactory conclusion.

AGENDA ITEM 3.8 2. There is a growing concern on the part of avionics shop owners and managers relative to acceptance standards for electronic supplies purchased from aviation wholesale dealers.

These supplies include wire, transmission cable, electrical/electronic parts, etc. Specifically, electrical wire is being offered by some distributors as MIL SPEC wire when in fact it carries no official labeling. We understand this area was a major topic of discussion at the recent national Aircraft Electronics Association (AEA) convention in Phoenix, Arizona. Repair stations appear to understand their responsibility to use only approved parts; however, certainly they are not a material testing lab and must use their limited knowledge of the product and supplier to assure approval status. We would suggest this area be discussed with a view toward future development of acceptable standards and documentation requirements in AC 43.13-1A and/or the TSO program.

We plan for the regional avionics specialist to attend this workshop. When available, please forward information on specific dates, registration, and accommodations.

JACK A. SAIN

AGENDA ITEM 3.9
ATE/BITE ACCEPTANCE

PROBLEM:

Automatic Test Equipment (ATE)/Built-In-Test Equipment (BITE) acceptance into the certifiate holder's maintenance program (Reference enclosed item from APC-242).

STATUS:

ACTION:

DISCUSSION:

ATE is not under AWS-100 jurisdiction for review/approval. Current FAA (AWS-300) Maintenance Handbooks (Air Carrier) have information and procedures for ATE. Past FAA practice's for BITE have been that, no credit or review was accomplished, unless an applicant requested credit. BITE has been evaluated to no unsafe feature.

AWS-330 encouraged Engineering review of BITE in order that Maintenance may use these systems for return to service credit.

CONCLUSION:

AWS-330 to coordinate engineering with Avionic Inspectors for BITE Certification by 6/80.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

MR SHERMAN APC-242

PACIFIC-ASIA REGION
P.O. BOX 50109
HONOLULU, HAWAII 96850

DATE 1979

REPLY TO APC-242:8300

SUBJECT 1979 Systems Workshop; Regional Avionics Inspector/Specialist Participation; AFS-800(833) letter dated May 25, 1979

FROM Chief, Flight Standards Division, APC-200

TO AFS-800

We concur with your recommendation on regional participation in the 1- to 2-day systems workshop and will send two representatives.

The following agenda items are proposed:

AGENDA ITEM 3.9 1. ATE/BITE acceptance into the certificate holder's maintenance program.

AGENDA ITEM 3.10 2. Discussion on the usefulness of the service difficulty report (SDR) program for avionics items. Some carriers and repair stations feel that their warranty and product problem reports to manufacturers are sufficient, and the SDR amounts to double reporting.

Robert L. Goodrich
ROBERT L. GOODRICH

AGENDA ITEM 3.10
SDR PROGRAM FOR
AVIONICS

PROBLEM:

Usefulness of the service difficulty report (SDR) program for avionics items (Reference Agenda Item 3.9 letter item 2 from APC-242).

STATUS:

ACTION:

DISCUSSION:

DOT/Transportation Systems Center have been engaged to review/expand the SDR program. AWS-330 reminded the attendee's that the MIS program had been discontinued to the field, however, airlines having computerized maintenance pograms, all failure reports may be available to FAA.

SDR reports, supported the Lithium Battery action. Therefore, the SDR usefulness has been recognized and continued use has been recommended.

CONCLUSION:

Attendee's recommended SDR program be continued.

AGENDA ITEM 3.11
NON-TSO'd PRODUCT INSTALLATIONS

PROBLEM:

Resolve differences between Engineering and Maintenance organizations pertaining to non-TSO'd equipment installations (Reference enclosed item from AGL-255).

STATUS:

ACTION:

DISCUSSION:

Inspectors are unknowlingly approving equipment/system(s) design, installation, and performance (of its intended function) if non-TSO'd equipment are not approved by some other means. AWS-330 Stated that academy training no longer presents attitude of indifference to the equipment design and performance requirements.

CONCLUSION:

AWS-330 to investigate the feasibility of developing a training course by 3/80.

AWS-330 to consider an AC for non-TSO'd equipment and incorporate (if appropriate) by 3/80.

AGL-255

SUBJECT: Resolve the differences of opinions between FAA Engineering and Flight Standards Maintenance pertaining to non-TSO'd product installations on general aviation aircraft

BACKGROUND: The authorized inspector or repair station installs a non-TSO'd product in an aircraft (Example: Radio NAV/COM Unit)

DISCUSSION: I think that the AI and/or the FAA Inspector are led to believe that it is the installation and only the installation that is signed for during an installation approval. It appears further that Engineering analyzes the situation differently, in that the party approving the item is approving the complete package, both installation, operation, and all parts included. At the FAA Academy Indoctrination Course the attitude was such that we don't care if there is a brick in the black box, all we care about is the installation.

RECOMMENDATION: I think it is time to resolve differences in interpretation since the complexity of avionic units and associated systems is continuously increasing. Therefore, once and for all, be it resolved between the two FAA groups exactly what is being approved by the signature and this applies to FAA Inspectors, repair stations, and authorized inspectors.

4.0 CERTIFICATION

AGENDA ITEM 4.1
STC MULTIPLE MODELS vs ONE MODEL

PROBLEM.

The desirabiltiy to STC total avionic systems installation, multiple models, and/or one model (Reference enclosed items from AGL-255 & AEA-213).

STATUS.

ACTION:

DISCUSSION:

AWS-130 recommended the regions review the AWE/AEA Handbook Supplements which have reduced the difficulties described in enclosed letters. Supplements:

8310.4a	WE Sup 1	(17 Oct. 1972)
8600.1	WE Sup 1	(21 Feb. 1979)
8600.1	EAFS Sup 1	(16 Aug. 1979)

CONCLUSION:

AWS-330/343 will transmit supplements to all regions by 11/79. All regions to review and incorporate (if appropriate) AWE and AEA supplements to 8600.1 by 1/80. AWS-330 review supplements for Washington action by 3/80.

AGL-255

AGENDA ITEM: Systems Workshop
October 1979/Orange County, California

SUBMITTED BY: AGL-GADO-13, Milwaukee, Wisconsin

SUBJECT: Engineering desires to STC entire avionics "package" installation on all future large aircraft a repair facility accomplishes on a stripped aircraft

BACKGROUND: Owner/operator obtained large aircraft from the factory stripped. A dual Omega system and INS system installed on this aircraft was STC'd. The rest of the Avionics installation was field approved.

DISCUSSION: Owner states that the procedure demanded is stifling, time consuming, costly and unnecessary.

If, in addition to relatively new navigational systems approvals under STC procedures, the Comms, ADF's, transponders also have to STC'd, a flight manual supplement will have to be written, drawing supplied and a flight check or checks will have to be accomplished, since these systems have been in use for many years, have not had STCs in the past in other aircraft and pose no particular problem, the question is asked, why now? It is argued that certain interface complexities not apparent to field inspectors plus pilot workload are justification for the STC. Present day transponders, ADFs and Comms are for the most part simple to operate due to advances in technology, thereby eliminating pilot workload and are not in any way interfaced with any other newly developed nav. systems.

RECOMMENDATION: Policy be established whereby complete systems can be approved by the field inspector. If a flight manual supplement or other engineering assistance is needed in the process of accomplishing the approval, that this be obtained without the usual resistance. "That being, tell the operator to apply for an STC".

AEA-213

Systems only

Subject: Assurance that field modifications do not adversely affect previous approvals.

Background: It was learned that a large external cargo pod had been approved for the DHC-6 aircraft, to someone other than DeHavilland, the TC holder. Apparently, this modification had been considered to be structurally satisfactory. However, the basic aircraft was approved for flight in icing conditions, which required considerable analysis and/or testing. There is no evidence that similar analysis and/or testing was conducted for the cargo pod modification. The side effect or by-product effect on icing flight capability of what might be an otherwise satisfactory modification can be easily overlooked in a field modification, with potentially serious results.

Available Options: 1. Prior to approval, require all modifications to an airplane by other than the TC holder to be reviewed by Regional engineering, unless the modification is of a kind frequently done, or is at least closely similar to a modification previously approved by the inspector.

2. Issue advisory material to field inspectors to make them more aware of the possible inter-relationships between modifications and existing approvals, and to encourage checking with Regional engineering offices, when modifictions are large, complex, or other than run of the mill.

Analysis of Operations: 1. This would reduce the inspector's authority, and put a greater workload on engineering, and increase the time needed to obtain an approval.

2. Requires preparation and distribution of appropriate guidance material.

Recommendation: It is recommended that advisory material be provided to field inspectors to make them more aware of the possible inter-relationships between modifications, and to encourage checking with Regional engineering offices when modifications are large, complex, or not run of the mill.

AGENDA ITEM 4.?
CERTIFICATION HAN... K

PROBLEM:

The suggested need for a data pertinent to certification requirements and procedures (Reference enclosed item from ANW-213).

STATUS:

ACTION:

DISCUSSION:

The attendee's agreed, that a "Certification Handbook" or a single reference source, for data pertinent to certification requirements and procedures, would be an extremely useful document. As a minimum, it was thought that a listing would be beneficial, if a total reference source could not be assembled.

CONCLUSION:

ASO-213 to transmit to AFO-510 the K. Blythe Policy package by 11/79. AFO-510 review the magnitude of the documentation and provide index to ANW-213 by 12/79. ANW-213 to assemble AFO-510, ASO-213, and AWS-130 (sent 10/79) input into a handbook by 1/80. AWS-130 to publish listing and/or handbook by 6/80.

ANW-213

A. PROBLEM

We need a "certification handbook", a single reference source for data pertinent to certification requirements and procedures, to be made available to the public as well as the FAA.

B. BACKGROUND

At the present time, there are no clear-cut guidelines for the various steps involved in the certification process. Individual FAA engineers learn what is expected of them through experience, and an applicant is advised of policy and procedures in each case as problems arise. FAA engineers new to the agency and inexperienced applicants often learn about policy, advisory circulars, procedures, or rules-of-thumb after the problem has been solved by a cognizant engineer. This is inefficient use of FAA manpower, and ofter causes consternation among the applicants.

C. AVAILABLE OPTIONS FOR A SOLUTION

1. No change to current publications, since all the required data is available through various government publications.

2. Consolidate all pertinent certification data into one handbook, such data to include advisory circulars, policy letters, orders, flight test guide (Order 8110.7 and 8110.8), and Order 8110.4, The Certification Handbook. and make these data available to the public.

D. ANALYSIS OF OPTIONS

Option C1

While it is true that all the required data and guidelines are available to the public as well as the FAA, these data are not contained in one publication, and therefore, this option should be rejected.

Option C2

Consolidation of all pertinent certification data into one handbook would reduce FAA paperwork, speed up the indoctrination of new personnel, eliminate variance in policy among regions, and allow applicants to be better prepared prior to contact with FAA engineers. It should be noted that these certification data should remain the responsibility of FAA personnel and not be made part of the public comment process.

E. RECOMMENDATION

It is recommended that Option C2 be accepted.

AGENDA ITEM 4.3
ENGINEERING CHANGES AND APPROVALS

PROBLEM.

Timely Engineering changes and approvals vs field approvals (Reference enclosed item from AGL-255).

STATUS.

ACTION.

DISCUSSION: (Ref. Agenda Item 4.1)

The attendee's generally agreed that there was no solution to the referenced type of problem. Applicants should be encouraged to utilize the DER's to the greatest extent possible.

AWS-130 and AWS-330/343 closer coordination between field offices and regional engineering.

CONCLUSION:

No further action.

AGL-255

AGENDA ITEM: Systems Workshop
October 1979/Orange County, California

SUBMITTED BY: AGL-GADO-6, Cleveland, Ohio

SUBJECT: Engineering Changes and Approvals

BACKGROUND: It has been our experience in the past that where the operator has sent in an application for an STC or installation approval on items such as an alternator, RNAV, propeller, etc., it takes months to process or get approval. Also changes by the manufacturer affecting certain serial numbers on identical models has been a problem.

DISCUSSION: There have been many times when the operator has an installation completed, the paper work has been processed and sent in for approval but he cannot use the aircraft until the approval goes through. Sometimes it takes several calls by field personnel to get some action.

A recent problem that came to our attention was a change on a propeller deicer boot installation. The aircraft manufacturer had changed vendors during the production run of a specific model aircraft at a certain serial number, yet this new vendor item was not approved for serial numbers previous to the one it was installed on, even though the installation drawings, instructions and hardware were the same. The aircraft model and propeller combination were also identical.

RECOMMENDATIONS: We recommend that regional engineering personnel visit the field more often so that they are cognizant of the problems field personnel are having. We also recommend that these minor approvals be handled by field personnel.

AGENDA ITEM 4.4
FUEL COMPUTER SYSTEM -
STC vs FIELD APPROVAL

PROBLEM.

Engineering and manufacturing involvment vs field approval of Fuel Computer system (Reference enclosed item from AGL-255).

STATUS:

ACTION:

DISCUSSION: (Ref. Agenda Item 26.1)

AWE-104 representative stated that AWS-140 in a national telecon discussed proposed guidance for fuel computers. A Draft Order, "Guidance Information for the Installation of Fuel Flowmeters in FAR 23 Airplanes" was transmitted on October 12, 1978, to each region for review and comments.

CONCLUSION:

AWS-130 will coordinate with AWS-140 the policy by 11/79.

AGL-255

SUBJECT: Hoskins CFS 2000 - Fuel Computer System, TSO'd to C44a and RTCA Document DO-160

BACKGROUND: These systems are being installed in aircraft in addition to the already existing aircraft fuel monitoring system.

DISCUSSION: Since the existing aircraft fuel system is not being changed or altered, field approvals are requested from the field. Are these approvals valid or should the item be incorporated by the use of an STC for each aircraft? Is flight testing of the aircraft by Engineering and Manufacturing personnel considered a "must do" item? May appropriately rated repair stations or AIs return the aircraft to service after the installation of the unit after field approval?

RECOMMENDATION: That there should be no "field approvals" on this item regardless if it is installed as an addition to the existing original fuel system or as a completely separate system. I think that Engineering should be involved in all aircraft fuel monitoring systems installed.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

DATE: October 12, 1978

IN REPLY REFER TO: AFS-140

SUBJECT: Draft Order, Guidance Information for the Installation of Fuel Flowmeters in FAR 23 airplanes

FROM: Chief, Pr⌃ ɹlsion Branch, AFS-140

TO: ANE-214, AEA-214, ASO-214, AGL-214, ARM-214, ACE-214, ASW-214, ANW-214, AWE-140

The enclosed draft order is forwarded for your review and comment.

Please provide your recommendations for additions or changes to this office by December 15, 1978.

RABetters
for THOMAS G. HOREFF

Enclosure

ORDER DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

DRAFT

SUBJ: GUIDANCE INFORMATION FOR THE INSTALLATION OF FUEL FLOWMETERS IN FAR 23 AIRPLANES

1. PURPOSE: This order prescribes guidance material relative to the installation of fuel flowmeters in type certificated airplanes either as an addition or replacement in an existing fuel system.

2. DISTRIBUTION: All Flight Standards Offices in Washington; to the Branch level; all Flight Standards Offices in the regions; to section levels; EMDO's; ACDO's; FSDO's; and GADO's.

3. BACKGROUND:

FAR 23.1305(g) requires a fuel pressure indicator for pump-fed engines. FAR 23.1549 requires a red radial or red line for each maximum and, if applicable, minimum safe operating limit, a green arc or line for the normal operating range, and a yellow arc or line for a precautionary range.

In recent years there has been a trend toward replacing fuel pressure indicators with fuel flowmeters and also toward substituting dial readout type flowmeters with digital readout types. This resulted in a number of questions regarding compliance with the aforementioned regulations. Some additional areas in question are as follows: 1) When is an STC for the engine required? 2) Should a flight manual supplement be required and what information should be given? 3) Should fuel tests be rerun? 4) Are placards acceptable to give limits for digital instruments?

4. GUIDANCE:

a. Engine STC.

The need for an engine STC must be determined for each particular installation. It is recommended that the installing region coordinate with the engine certification region to determine whether the engine manufacturer has specific instructions regarding the installation of flowmeters and whether they believe an engine STC is necessary. When hardware changes are made and such changes could possibly be affected by future AD action, an engine STC is mandatory. In any case, the engine manufacturer's input should be obtained.

Also, when a flowmeter is being replaced and the existing flowmeter has defined limits (green arc, etc.) the airplane certificating region should be contacted to determine the need for these markings.

Distribution: Initiated By:

DRAFT

b. Flight Manual Supplement.

Information on the operation and use of a newly installed flowmeter should be furnished in a flight manual supplement (if provided) or in any combination of approved manual material, markings, and placards.

c. Fuel Tests.

A determination as to whether hot fuel tests and/or fuel flow tests need to be conducted must be made for each specific installation. An engineering judgement must be made whether the new installation introduces any changes that would make the fuel system conducive to vapor formation. If so, hot fuel tests should be conducted. With regard to fuel flow, if the metered fuel to the engine can be adjusted to account for the pressure drop across the fuel flow transducer, a rerun of the fuel flow test is not necessary. In any case, the region having certification responsibility for the engine and airplane should be consulted.

If there is any doubt that either the system is conducive to vapor lock or that fuel flow will be adversely affected after the flowmeter system is installed, then the necessary fuel flow tests should be run.

d. Placards for Digital Instruments.

When either the engine or airplane manufacturer has established definite limits (Pressure or flow) then a placard is not an acceptable means for displaying these limits. Instrument markings are required per FAR 23.1549.

e. Field Approvals.

Order 8310.4A paragraph 71j requires that Engineering approval be obtained for fuel system changes that may adversely affect their operation. It is mandatory that requests for approval of a fuel flowmeter installation be coordinated with Engineering and Manufacturing.

AGENDA ITEM 4.5
STC or 337 INCONSISTENCIES

PROBLEM.

Inconsistencies in approving major alterations of avionic equipment in aircraft - STC or 337 (Reference enclosed Agenda Item 20.5, AEA-252 letter item 2).

STATUS.

ACTION.

DISCUSSION. (Ref. Agenda Item 3.4a and 4.1)

General discussion by the attendee's reinforced the inconsistencies in approving major alterations.

AWS-330 stated that Handbook 8320.12 indicates the inspector makes the appropriate judgement on these issues of minor/major alterations.

CONCLUSION:

AWS-130 to coordinate with AGC and attempt to acquire an interpretation of minor/major approvals by 1/80.

AGENDA ITEM 4.6
NEW TECHNOLOGY TSO'd EQUIPMENT

PROBLEM:

Replacement of TSO'd avionics equipment in type certified systems (Reference enclosed item from ANW-210).

STATUS:

ACTION:

DISCUSSION: (Ref. Agenda Item 6.2 & 6.4)

General discussions pointed to the fact, that when new technology has been implemented or when technology has been upgraded i.e., analog to digital, then the equipment/system should be considered as a major change, at least until sufficient experience has been acquired on the technology, equipment, system, etc.

It was suggested, that software would be considered a major change. All software changes should be identified and controlled for each TSO'd equipment, by Dash No. to the equipment and by a means to the crew and maintenance personnel.

CONCLUSION:

Ref. Agenda Item 6.2 for the associated draft AC.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ANW-210

NORTHWEST REGION
FAA BUILDING KING COUNTY INT'L AIRPORT
SEATTLE, WASHINGTON 98108

FEDERAL AVIATION ADMINISTRATION

In Reply
Refer To: ANW-213:8150

Boeing Commercial Airplane Company
Attention: Mr. H. J. Badger, Chief
Safety and Airworthiness
P.O. Box 3707
Seattle, Washington 98124

Subject: Replacement of TSO'ed avionics equipment in type certified systems

Gentlemen:

New technology TSO'ed equipment has been and is being introduced into transport aircraft service. Some of this equipment is used as part of systems such as automatic flight controls. An example of this is the new Collins, King, and Bendix light weight digital navigation receivers.

To obtain the initial type certification, analysis and testing were conducted on the autopilot system to show compliance with the applicable regulations. This analysis would typically include performance and safety analysis of the system including the TSO'ed parts.

Whenever a portion of a type certified system is replaced, an analysis and/or testing must be conducted to show that the type certified system is still in compliance with the applicable regulation.

It is therefore necessary that when you request certification of TSO'ed parts which are part of type certified systems, the DER responsible for the affected system assess the impact of the replacement part on the certification and that statements as to the impact be included in the request. For TSO'ed parts using digital computational techniques, software must be considered in assessing the impact.

Sincerely,

Charles C Schroeder

CHARLES C. SCHROEDER
Chief, Engr. & Mfg. Branch, ANW-210

5.0 DESIGNATED ENGINEERING REPRESENTATIVE

AGENDA ITEM 5.1
DER HANDBOOK

PROBLEM:

DER Handbook (new) issuance, r .w/comment, and implementation (Reference 1977 Agenda Item 34

STATUS:

Handbook has not been issued nor has review of 8600.1, 8110.4, 8320.12, 8110.10B, been completed.

ACTION:

AWS-130 will provide status at workshop.

DISCUSSION:

During the meeting 8320.12 ch. 6 and 8600.1 ch. 381 were reviewed by AWS-330/343 and found to be in agreement with current DER utilization practices by field personnel, as well as 8110.4 ch. 4 (draft revision). 8110.10b has been updated to an 8110.10c.

The DER contact in Washington, D.C. is Ed Chapman, AWS-111, Phone (202) 426-8192, for all DER package questions and problems.

CONCLUSION:

DER Handbook 8110.37 is to be published by 12/79. 8110.4 Ch. 3 (Systems) is to be published by 12/79.

AGENDA ITEM 5.2
DER ACCEPTANCE BETWEEN REGIONS

PROBLEM:

Discussion relative to DER interregion acceptance & relationships.

STATUS:

DER's acceptance between regions are to be emphasized in DER handbook.

ACTION:

AWS-130 will attempt to have DER interregion relationships included in the DER handbook.

DISCUSSION:

8110.37 (Draft) DER Handbook [Ref. Section: "Acting Outside of Supervising Region"] provides guidance for DER acceptance. It was suggested that 8110.4 is to be reviewed and compared with 8110.37 for compatibility.

CONCLUSION:

AWS-130 will investigate 8110.4 vs DER Handbook on Interregion DER Activity by 2/80.

AGENDA ITEM 5.3
DER FORUM

PROBLEM.

Suggested DER Forum (and Agenda) appears of limited interest (Reference 1977 Agenda Item 47).

STATUS:

No comments were received from DER's to date.

ACTION:

AWS-130 will query DER's at workshop for desirability for a national meeting of DER's in 1980 on DER administrative details.

DISCUSSION:

The DER's generally agreed that a national forum should be conducted at least once every two years. DER's suggested that they be solicited for agenda items prior to any workshop.

CONCLUSION:

No further action.

6.0 INTEGRATED SYSTEMS

AGENDA ITEM 6.1
COMPLEX SYSTEMS

PROBLEM:

Complex systems certification considerations and control (Reference 1977 Agenda Item 17).

STATUS:

AWS-130 concurs with AWE-130 proposal to control interface equipment of complex digital flight control and avionics systems/equipment. AWS-130 intends to have AFO-512 incorporate the recommendation into 8110.4 now under revision. We believe AC action after our first or second workshop on digital systems would be appropriate time for issuing that guidance material.

ACTION:

AWS-130 will advise AFO-512 to pick up AWE-130 recommendation into current revision activity of 8110.4.

DISCUSSION:

Special emphasis was thought necessary in 8110.4 Ch. 3 for interfacing of complex equipment.

CONCLUSION:

The new revision to 8110.4 Ch. 3 para. 96(e) does include the necessary information for interfacing of complex equipment.

No further action.

AGENDA ITEM 6.2
DIGITAL FLIGHT CONTROL AND AVIONIC SYSTEMS

PROBLEM:

Digital Systems installation guidance revaluation and approval (Reference 1977 Agenda Item 18).

STATUS:

AWS-130 believes the cautions presented by ANW-213 paper provides appropriate guidance in handling the coming generation of equipment.

ACTION.

AWS-130 is intending to draft guidance material in this area.

DISCUSSION: (Ref. Agenda Item 4.6)

A draft Digital Flight Control AC was disseminated at the workshop. An overview discussion was conducted.

CONCLUSION:

All regions to review/comment to draft AC by 11/79.

AWS-130 to finalize AC by 1/80.

DRAFT 10/1/79

DIGITAL FLIGHT CONTROL AND DIGITAL AVIONIC SYSTEMS

INSTALLATION GUIDANCE

1. PURPOSE: This advisory circular establishes an acceptable means, but not the only means of obtaining airworthiness approval of Airborne Digital Flight Control and Digital Avionic Systems (and equipment) intended for installation in U.S. civil aircraft.

2. CANCELLATION. (Reserved)

3. REFERENCES. Federal Aviation Regulations Parts 21,23,25,27,29, and 135, Appendix A.

4. BACKGROUND.

a. Digital flight control and avionics equipment and systems have oeen installed and certificated in U.S. civil aircraft for a number of years. They were introduced in inertial navigation systems (INS), air data computers, communication equipment and other navigation systems such as VOR, DME, RNAV, and OMEGA. These digital equipments introduced the generating of these functions by digital techniques. Digital techniques are where functions are realized by sequential execution of stored instructions by a general purpose arithemetic logic unit.

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ADVISORY CIRCULAR

DIGITAL FLIGHT CONTROL AND AVIONICS INSTALLATION GUIDANCE

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b. The digital systems have become quite complex with recent area navigation (RNAV) and flight management systems (FMS). The results of airworthiness review and in-service experience has indicated a need for a special emphasis on digital flight control and avionic evaluation to assure that system performance and failure aspects are adequately investigated particularly when involved with "flight critical" systems such as the aircraft flight controls.

c. The FAA anticipates the aviation industry will eventually digitize all major avionic systems. For those systems considered "flight critical"; i.e., failure would not permit continued safe flight and landing, the evaluation by the applicant is expected to be of greater depth than was required on digital systems approved in the past.

5. DEFINITIONS.

a. Functions

(1) Nonrequired Functions - As defined, functions which if lost, result in no restriction on aircraft tasks or significant increase in flight crew workload.

(2) Flight Mission Essential Functions - Functions which if lost result in certain tasks being prohibited, i.e., autoland, RNAV, etc.

(3) Flight Envelope Essential Functions - Functions which if lost result in restricted flight envelope, i.e., 727 yaw damper, Mach trim, etc.

(4) "Flight Critical"/Essential Functions - Functions which if lost in flight would be impossible or impractical, i.e., full fly-by-wire, critical stability augmentation, etc.

b. Systems

(1) Flight critical system - Systems which perform functions in which continued safe flight and landing would be jeopardized or impossible if the function was not performed due to system failure or software error.

(2) Nonflight critical system - Systems which perform functions in which continued safe flight and landing would not be jeopardized by a system failure or software error.

(3) Nonrequired systems - Systems which perform functions in which if lost be system failure or software error, no restriction or limitation is placed on the aircraft and the pilot's workload is not significantly increased.

c. General Terms

(1) System failure - Any single failure, sequence or combination of latent failures which results in loss of function.

(2) Software - The stored set of instructions which when executed controls the digital computing system.

(3) Software error - Any numerical instability, corruption of stored data or scaling error which would result in the loss of the function.

(4) Verification - Evaluations performed to confirm that the software meets all specified requirements.

(5) Validation - Testing and analysis done to confirm that the system/ software performs the intended functions.

6. General. Applicants desiring approval of digital flight control and digital avionic systems (and equipments) in accordance with this advisory circular should contact the appropriate FAA office well in advance of the proposed approval date. Appropriate documentation should be provided with the application which would describe (as a minimum) the major phases (and milestones) of the design, development and certification of the system. The analysis, validation, verification and documentation of nonrequired functions is minimal. It must be shown that the design will perform its intended function and that it will not interfere with the operation of required systems.

You will note in the ensuing discussions, ~~and Appendix A,~~ that the criticality is defined by function not by system. This is because future systems may integrate many heretofore independent systems (functions) into a single hardware system.

The analysis, verification, validation and documentation for mission, envelope and flight critical functions is essentially the same with only the probability of loss of function and therefore the depth of the analysis being different.

The depth of the analysis, verification, validation and documentation depends upon the criticality of the functions being performed by the systems (i.e., non-flight & flight).

7. DISCUSSION. Digital system considerations should be given as follows:

a. Verification and Validation. The applicant should conduct and document a verification and validation program to assure all intended functions (performance and safety criteria) are correctly performed and

unintended functions are shown not to occur when the system(s)/equipment are comprehensively tested.

(1) Software Considerations - Verification and validation procedures should be used which show that when the computer executes the program instruction sequence, the intended function is realized. These procedures should include, but not be restricted to, the following:

(a) Analysis of all logic and arithmetic computational algorithms showing acceptable performance for the full range if possible inputs, i.e., frequency response, resolution, stability, etc.

(b) Verification establishing that the correctness of the software is in compliance with the appropriate regulation for the function performed.

(c) Validation that the program sequence performs the intended function.

(2) Validation Techniques and Tools.

Various validation techniques, methods, and tools provide aids in validating system(s)/equipment. A set of appropriate techniques, methods, and tools must be selected and combined into a total validation program that provides complete coverage of all aspects of the system development process from definition of goals to production. For illustrative purposes, the validation process may include:

- Analyses, modeling, computer simulation, emulation.
- Failure mode & effects analysis (FMEA), failure mode and effects tests (FMET), reliability analysis and test methods.
- Fault injection, simulation testing
- Integrated systems tests, flight tests
- Acceptance testing

Acceptable validation procedures may be developed jointly by parties involved, including the FAA.

(3) Independent assessment

The FAA considers that both hardware and software systems may benefit from independent assessment. The FAA may, based upon its satisfactory review of a software speciality company's qualifications if the applicant provides one, accept it's independent assessment and resulting findings of software verification and validation.

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Such independent assessment should be submitted with the original validation data as a part of the certification package.

(3) Systems Considerations - The system analysis should include, but not be restricted to do the following:

. Complete system implementation analysis showing system scaling and stability margins. Analysis should include sensors, actuators and aerodynamic effects.

. Testing to show that the system performs the intended function over the range of operational conditions.

b. Non-Flight Critical. For those systems (and equipments) in which continued safe flight and landing would not be jeopardized by a failure, e.g., single communication transceiver or navigation receiver such as VOR, DME, RNAV, or OMEGA, the following guidance is provided:

(1) System(s) Design:

Systems (and equipments) produced under a Technical Standard Order (TSO) or FAA recognized industry (i.e., RTCA, SAE, etc.) standard or performance specifications should be installed in accordance with the regulations and advisory circulars written for the particular system. The digital techniques should be reviewed as follows:

(a) Hardware Considerations. Current techniques should be utilized as done for analog hardware with special emphasis on electromagnetic interference (EMI), lightning effects analysis, cooling requirements, and effects of maintenance handling including possible damage from extraneous static electricity.

(i) The equipment should comply with the appropriate environmental specification for the aircraft environment in which the equipment will be installed.

(ii) The system availability should be shown to be consistent with the requirement for the functions performed.

(iii) The passive failure rate of the system, which could result in loss of function, must be shown to be in compliance with the appropriate regulation for the function performed by the system.

In showing compliance, consideration should be given to the following:

(a) Reliability of the hardware components.

(b) Coverage, reliability and confidence level of monitoring.
(c) Time between periodic tests.
(d) Reliability of warning devices and pilot workload, if manual takeover or override is required.

For the initial certification, the reliability analysis can be based on service experience or predicted values using military or industrial standards.

(b) Software Considerations. It is recommended that traditional steps for problem solving, i.e., problem definition, analysis, and implementation be utilized. Top-down design and structured programming are acceptable means for software design and development, control, and evaluation. A procedure should be instituted to properly evaluate, test, document, and identify subsequent software changes, both during and after certification.

c. Flight Critical. For those systems for which continued safe flight and landing could be threatened by a failure of the system: e.g., flight control system, pressurization system, low visibility approach systems, and active control systems, the following guidance is provided:

(1) System(s) Design:

Systems (and equipments) produced under a Technical Standard Order (TSO) or FAA recognized industry standard or performance specification i.e., RTCA, SAE etc. should be installed in accordance with the regulations and advisory cirulcars written for the particular system.

(a) Hardware Considerations.

(i) System achitecture should be substantiated with regard to redundancy techniques to insure reliability.

(ii) Sensors and power supplies should be substantiated with regard to redundancy and backup capability.

(iii) Displays, controls, and actuators should be reviewed for interface requirements and reliability.

(iv) Necessity for self-test, failure detection, failure annuciation, failure isolation and crew corrective action should be evaluated.

(v) Computer processor architecture should be reviewed for appropriateness for the intended purposes, including redundancy considerations. Failure detection and isolation techniques need substantiation including handling of latent (undetected) failures.

(vi) A reliability analysis, such as a failure mode and effect analysis (FMEA) should be provided.

(b) Software Considerations. Applicant should conduct a verification and validation program of the complete system to assure all intended functions are correctly performed and unintended functions are shown not to occur when the equipment is comprehensively tested. This is to consider:

(i) Requirements analysis - to assure software requirements are correctly derived from system requirements and that the system hardware & software are compatible, via the following typical techniques:

. Independent derivation of software requirements from system requiremen. .

. Comparison to a reference system previously successfully developed (if available.)

. Functional simulation/emulation.

. Timing and sizing analysis with established budgets for system parameters.

(ii) Design analysis-to assure proposed mathematical equations-algorithms satisfy system requirements.

. Correlation and traceability between system functions and software requirements.

. Functional simulation emulation to assess design integrity.

. Independent derivation of equations and algorithms.

. Comparisons with reference models that are operational and, their proven methods (if available).

. Mathematical and logical analysis.

(iii) Code analysis - to assure code correctly implements software design, standards followed, no latent errors. This should consider:

- Text editing and syntax analysis.
- Standards auditing.
- Equation reconstruction, if required, depending on the extent of other verification methods and the critically of the function.
- Flow charting or equivalent methods of logic reconstruction.
- Manual code inspection by different persons.

(iv) Integration analysis - to assure modules, software interfaces, and complete integrated program operate properly via testing. This should include:

- Module testing.
- Interface testing.
- System testing. <u>Note</u>: All software testing should be comprehensive and include:

- Many test points covering the full ranges of all variables; input, output, and internal, including probable input source failure cases.

- Behavior resulting from sign changes in all variables as appropriate, including small values and zero.

- Behaviors resulting from any variables capable of approaching extreme values (i.e., tangents of angles near 90 degrees).

- Behavior resulting from any software implementation of mathematical operations which may, for certain ranges of variables, be undefined in terms of real numbers, such as arcsines or arguments whose magnitudes exceed one.

- Return of appropriate or correct result for any functions which may be multi-valued, such as square roots or inverse trigonometric functions.

- Exercising of all decision points.

- All modes of operation available to the flight crew.

These tests should be sufficiently comprehensive to verify that unintended functions are unlikely to occur.

8. DATA PACKAGE/PROGRAM.

a. System(s) Description

A documentation or group of documents shall be provided which include both top level and sub level definitions of system(s) functions, operational characteristics, peformance limits, and hardware/software requirements.

Documentation covering all items listed for each category should be submitted prior to desired certification date: nonrequired function, 30 days; noncritical function, 2 months; and critical function, 3 months.

b. Safety Analysis/Assessment

A comprehensive safety analysis plan shall be provided which describes the fault (and fault effects) and fault-free analysis efforts, failure and failure-free performance efforts, and safety assessment correlation.

c. Validation Results

Following the system(s) development, hardware/software testing, environmental qualification, and integrated systems tests, the results should be provided.

d. Simulation

Iron and electronic bird simulation and demonstrations may be conducted which will provide system(s) compatibility data prior to initiating a flight test program. The results should establish a baseline for the flight demonstrations and should be provided.

e. Flight Demonstration

The flight test phase data provided generally describes the development test activities, confirmation of specified performance levels, and demonstration of system(s) operation and safety. The certification flight demonstration should include all system(s) modes of operation, emergency or abnormal conditions, and crew workload observations.

9. SYSTEM DEMONSTRATION

a. System(s) Installation

(1) System(s) control and display(s) should be visible to and conveniently accessible to, the crew seated at their duty station. Adjustments and controls not intended for crew operation should not be accessible to the crew.

(2) The electrical power for the system(s) should be obtained from a bus that provides maximum reliability of electrical power without jeopardizing service to essential or emergency loads. Effects of transfers and temporary power outages should be demonstrated.

(3) A functional check should be performed to demonstrate compatibility between the digital flight control and avionic system(s) and aircraft electrical/electronic equipment operating normally on aircraft power. Proper ground design should be used in order to minimize the effects of external EMI.

b. Airplane Flight Manual (AFM)

The need for an airplane flight manual should be assessed on system function and not on its type of technology with regard to limitations and normal, emergency or abnormal operating procedures.

c. Demonstration of Compliance

An applicant for approval of a digital flight control and digital avionic system(s) (and equipments) installation should show that he has satisfied the requirements by a combination of ground and flight tests for all system(s) modes and ranges of operation.

(1) General: Sufficient ground and flight tests should be conductd to validate proper system function in the aircraft.

(a) Ground tests. The applicant ground test program in the aircraft should include those items that need not be done in flight.

(b) Flight tests. The digital system should be checked in flight to determine that the design and installation criteria are met. All modes of operation should be functionally checked. The aircraft flight manual (if required) should be evaluated in flight.

(i) For "non-critical" systems, sufficient tests should be conducted to evaluate normal or expected equipment operation during all flight regimes. Fault testing should be limited to those critical failures whose exact outcome could not be determined in previous analyses or groundtesting.

(ii) For "flight-critical" systems, more comprehensive flight tests are needed. These should include all modes of operation available to the flight crew, all configurations and all critical areas of the flight enevelope in which the system is used. Performance should be

verified. All faults should be tested where their ocurrence has not been determined by analysis or ground tests to have no significant effect on the aircraft flight path or detrimental effects on aircraft safety. Sufficient data should be accumulated to provide a high level of confidence in the results.

Note: Reference Advisory Circular 21-14 for the use of simulators in lieu of a part of the flight test program.

10. INSPECTION AND TEST

Appliant should recommend procedures which will be used to inspect and test the equipment periodically to determine that it is operating in accordance with the manufacturer's performance specifications. Such procedures should include a method for analyzing and reporting malfunctions and defects, to determine that the established inspections and tests give reasonable assurance that the equipment is maintaining its accuracy. Test and inspection procedures and intervals should be adjusted in accordance with the results of the analysis, in order to maintain the certification criteria throughout service life, including probabalistic failure rate crriteria if appropriate.

Appendix A

Abbreviations

AC	Advisory Circular
AFM	Aircraft Flight Manual
ARINC	Aeronautical Radio, Inc.
DME	Distance Measuring Equipment
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FMEA	Failure Modes and Effects Analysis
FMET	Failure Modes and Effects Testing
FMS	Flight Management Systems
INS	Inertial Navigation System
OMEGA	Aviation/Marine Global Navigation
RNAV	Area Navigation
RTCA	Radio Technical Commission for Aeronautics
SAE	Society of Automotive Engineers
TSO	Technical Standards Orders
U.S.	United States
V&V	Verification and Validation
VOR	Very High Frequency Omni-Range

AGENDA ITEM 6.3
LIGHTNING STRIKE PROTECTION
(PARTS 23, 25, 27, & 29)

PROBLEM:

Advanced digital flight control and avionic systems (equipments), and composite aircraft structures, are more vulnerable to direct lightning strikes/induced effects (transients) (Reference 1977 Agenda Item 14, and enclosed item from ANW-213).

STATUS:

Scotty Salmond's proposed AC was not considered of sufficient value to utilize. The report AAC 213-15 dated December 1975 will be utilized as supporting documentation for lightning guidance material.

ACTION:

AWS-130 will initiate an AC project to include latest guidance of SAE, MIL-STD, AAC, Plummer, & NASA lightning report(s) for Systems lightning protection/qualification testing guidance.

DISCUSSION:

A general overview of the lightning subject (i.e., NASA, DOD, workshop, and programs) were presented. The following documents were referenced: SAE Committee AE4L, "Lightning Test Waveforms and Techiques for Aerospace Vehicles and Hardware"; Fisher/Plummer "Lightning Protection of Aircraft," NASA Publication 1008; MIL-STD-XXXX, "Lightning Qualification Test Techniques for Aerospace Vehicles and Hardware (March 1979); FAR 27/29 "Lightning Protection" Proposals (enclosed).

A draft Lightning AC for direct/indirect effects to be developed referencing pertinent guidance material.

CONCLUSION:

AWS-130 to provide a draft AC by 1/80.

AWE-ACDO-33 to survey and provide an update on the UAL Lightning program by 1/80.

A. PROBLEM

Electronic equipment contained within advanced composite aircraft structures are more vulnerable to lightning-induced transients than those equipment within the conventional aluminum structures. Conventional aluminum aircraft are well shielded against the indirect effects of lightning. However, this is not true for the advanced composite aircraft because of the composite's relatively low electrical conductivity. For this reason, the need for protection of the equipment contained within the latter has increased with prospects of integrated circuit technology becoming even more delicate, power problems. Reference FARs 25.581 and 25.1309.

B. BACKGROUND

Search for new, high-strength, high stiffness materials has renewed our interest in carbon/graphite fibers since they were first introduced in the early 1960's. Studies based on the production of advanced composite aerospace structures indicate that utilization of composite components containing these fibers in aircraft structures add strength, reduce weight, and provide significant benefits in cost and performance. Yet, even with these salient features of the advanced composite materials, their application on aircraft could be inhibited in some areas of aircraft structures because of potential problems resulting from lightning strikes.

C. AVAILABLE OPTIONS FOR A SOLUTION

Option 1: Aluminum flame-spray - For equipment located in an area of swept-stroke zone, coat the entire exterior composite surface with an aluminum flame-spray. This can provide a protective system that will not exceed safe voltage and current levels of components and of wiring for all affected systems.

Option 2: Transient suppression devices - For equipment located in an area other than the swept-stroke zone, continue to use the appropriate transient suppression devices to protect the rest of the circuit from transients.

D. ANALYSIS OF OPTIONS

Option 1 - Application of aluminum flame-spray to exterior surface of advanced composite structures will preclude the damage of delicate, electronic equipment contained within these structures from induced effects of lightning. The flame-spray coating will act as a shielding against magnetic flux, which may penetrate non-metallic structures, and will minimize their interference. A possible application of this flame-spray is in an area of swept-stroke zone, such as in the engine cowl panel. In the engine cowl panel, the flame-spray applied to panel surface will shield engine wiring from the induced effects of a lightning strike to the engine. For example, an analysis made by Boeing shows the voltage induced by a severe strike on the Model 727 engine wiring beneath aluminum flame-sprayed

Kevlar cowl is approximately 150 volts. They concluded that this margin of safety is considered sufficient because the minimum voltage threshold for damage on any Model 727 engine circuit is 450 volts.

For the flame-spray to be effective, the thickness of flame-spray must be properly controlled, otherwise, inconsistencies can result in supplying protection against lightning. A 5.45-mil thick, aluminum flame-spray coverage is adequate to keep the current to the external skin of the fuselage. Further, if the spray is electrically bonded to structures, an additional EMI shielding is provided.

Option 2 - Most susceptible components in a circuit are usually the zener diodes, added to protect the rest of the circuit from transients. If the use of diodes are not suitable for protection in certain circuits, the following transient suppressions should be considered: (1) those that block transients, preventing their propagation into the sensitive circuits; and (2) those that divert transients away from sensitive loads so as to limit the residual voltage.

If electronic equipment containing a transient suppressor continued to experience transient losses, speed of transient response should be checked. Losses are attributed to the slow response time of the transient suppressor. There are some suppressors that do not respond fast enough to protect the integrated circuits and semiconductors used in a microprocessor-base technology. Protection failure occurs because transients that cause the degradation of the electronic equipment are in the nanosecond or less and not on the microsecond range. For example, a 100-picosecond transient has been reported to damage such elements as ECL logic units. Therefore, for selection of the proper transient suppressor, speed response should be included during the design evaluation.

E. RECOMMENDATION

a. Use Option 1 for swept-stroke zone.

b. Use Option 2 for direct lightning-strike zone.

Proposal:
From: FAA, AFS-130
Index:
FAR: 27.581 (New)
Subject: Lightning Protectection

Proposal	Current Rule
Add new § 27.581 to read as follows:	None

§ 27.581 Lightning Protection

* * * * *

(a) The rotorcraft must be protected against catastrophic effects from lightning.

(b) For metallic component(s), compliance with para (a) of this section may be shown by:

1) Bonding the component(s) properly to the airframe, or

2) Designing the component(s) so that a direct strike or swept-stroke attachment will not disable the rotorcraft.

(c) For non-metallic component(s), compliance with para (a) of this section may be shown by:

1) Designing the component(s) to minimize the effect of a direct strike or swept-stroke attachment, or

2) Incorporating acceptable means of diverting the resulting electrical stroke component(s), so as not to endanger the rotorcraft.

EXPLANATION AND JUSTIFICATION

Rotorcraft certificated for operation under Instrument Flight Rules (IFR) are subject to damage from the increased exposure to lightning strikes at operational altittudes (from 1500 to 15,000 feet).

Proposal:
From: FAA, AFS-130
Index:
FAR: 29.581 (New)
Subject: Lightning Protectection

Proposal	Current Rule
Add new § 29.581 to read as follows:	None

§ 29.581 Lightning Protection

* * * * *

(a) The rotorcraft must be protected against catastrophic effects from lightning.

(b) For metallic component(s), compliance with para (a) of this section may be shown by:

1) Bonding the component(s) properly to the airframe, or

2) Designing the component(s) so that a direct strike or swept-stroke attachment will not disable the rotorcraft.

(c) For non-metallic component(s), compliance with para (a) of this section may be shown by:

1) Designing the component(s) to minimize the effect of a direct strike or swept-stroke attachment, or

2) Incorporating acceptable means of diverting the resulting electrical stroke component(s), so as not to endanger the rotorcraft.

EXPLANATION AND JUSTIFICATION

Rotorcraft certificated for operation under Instrument Flight Rules (IFR) are subject to damage from the increased exposure to lightning strikes at operational altittudes (from 1500 to 15,000 feet).

Proposal:
From: FAA, AFS-140
Index:
FAR: 27.954(New) [Ref. AC 20-53]
Subject: Fuel System Lightning Protection.

Proposal	Current Rule
Add new § 27.954 to read as follows:	None

The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by-

(a) Direct lightning strikes to areas having a high probability of stroke attachment;

(b) Swept lightning strokes to areas where swept strokes are highly probable; and

(c) Corona and streamering at fuel vent outlets.

EXPLANATION AND JUSTIFICATION

Normal category rotorcraft with large rotor blades and considerable composite structure are especially subject to damage from lightning strikes. As a minimum, current FAR 25 rules are applicable and should be proposed.

Proposal:
From: FAA, AFS-140
Index:
FAR: 29.954(New) [Ref. AC 20-53]
Subject: Fuel System Lightning Protection.

Proposal	Current Rule
Add new § 29.954 to read as follows:	None

The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by-

(a) Direct lightning strikes to areas having a high probability of stroke attachment;

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(c) Corona and streamering at fuel vent outlets.

EXPLANATION AND JUSTIFICATION

Normal category rotorcraft with large rotor blades and considerable composite structure are especially subject to damage from lightning strikes. As a minimum, current FAR 25 rules are applicable and should be proposed.

Proposal:
From: FAA, AFS-130
Index:
FAR: 27.1310(New)
Subject: Systems/Equipment Lightning "Induced Effects " Protection/ Hardening

Proposal	Current Rule
Add new § 27.1310 to read as follows:	None

§ 27.1310 Systems/Equipment Lightning "Induced Effects " Protection/Hardening

* * * * *

(a) The rotorcraft systems/equipment must be protected against lightning induced effects which may be catastrophic, by:

(b) The external structure which may be hardened to greatly reduce or prevent the penetration of lightning electro-magnetic or transient interference into the rotorcraft, and/or

(c) The hardening of electronic circuits, subsystems, systems and/or equipments, and/or

(d) The shielding of equipment and interfacing, control, signal, and power cables, and/or

(e) Combinations of items (b), (c), and (d).

EXPLANATION AND JUSTIFICATION

Rotorcraft systems/ equipment installations within a minimum aluminum structure, (increased use of composite structure) and are more susceptible to the induced effects of a near or direct lightning strikes operating under Instrument Flight Rules (IFR). These damage or catostrophic effects must be minimized by protection/hardening techniques.

Proposal:
From: FAA, AFS-130
Index:
FAR: 29.1310(New)
Subject: Systems/Equipment Lightning "Induced Effects" Protection/ Hardening

Proposal	Current Rule
Add new § 29.1310 to read as follows:	None

§ 29.1310 Systems/Equipment Lightning "Induced Effects" Protection/Hardening

* * * * *

(a) The rotorcraft systems/equipment must be protected against lightning induced effects which may be catastrophic, by:

(b) The external structure which may be hardened to greatly reduce or prevent the penetration of lightning electromagnetic or transient interference into the rotorcraft, and/or

(c) The hardening of electronic circuits, subsystems, systems and/or equipments, and/or

(d) The shielding of equipment and interfacing, control, signal, and power cables, and/or

(e) Combinations of items (b), (c), and (d).

EXPLANATION AND JUSTIFICATION

Rotorcraft systems/ equipment installations within a minimum aluminum structure, (increased use of composite structure) and are more susceptible to the induced effects of a near or direct lightning strikes operating under Instrument Flight Rules (IFR). These damage or catostrophic effects must be minimized by protection/hardening techniques.

AGENDA ITEM 6.4
APPROVAL OF COMPUTER
SOFTWARE CHANGES

PROBLEM:

How should software changes be handled? (Reference enclosed item from AWE-130).

STATUS:

ACTION.

DISCUSSION: (Ref. Agenda Item 4.6 and 6.2)

General discussion of the AWE-130 and ANW-213 inputs. It was strongly recommended that a policy letter be initiated for software program changes.

It was suggested that software would be considered a major change. All software changes should be identified and controlled for each TSO'd equipment, by dash no. to the equipment and by a means to the crew and maintenance personnel.

CONCLUSION.

AWS-130 to develop/issue a policy letter for software program changes by 12/79.

AWE-2130

AGENDA ITEM

DESCRIPTION, EVALUATION, IDENTIFICATION AND APPROVAL OF COMPUTER SOFTWARE CHANGES

SUBJECT

Because of the development of the microprocessor and of computer miniaturization, an ever increasing number of aircraft functions can now be computer controlled. We are on the threshold of an entirely new generation of aircraft, where every flight control function, each operational mode, and every performance parameter can be monitored and controlled by computer. It is the FAA's responsibility to determine aircraft airworthiness which may depend to a very large degree on various computers and the software installed in them.

DISCUSSION

Continuously evolving technology causes continuous changes in computer software. Some software changes may have no discernible effect upon the aircraft and are introduced only to market a more consumer palatable or cost effective product. Other software changes may have a very pronounced effect on the aircraft. The question arises: "How should software changes be handled by FAA personnel?"

OPTIONS

1. Ignore software changes.
2. Leave it up to the manufacturer or DER to handle software changes.
3. Evaluate and control software changes.

ANALYSIS OF OPTIONS

1. Software changes cannot be ignored; they may be as important to flight safety as a lost engine, a frozen control surface, or a structurally weak wing. FAA must make a finding that compliance with Section .1309 of FAR 23, 25, 27, or 29 has been achieved, no matter what software has been installed.

2. The manufacturer or applicant cannot, under normal circumstances, approve his own product or installation. At this stage of the game, DER approval of software and software changes is definitely not recommended. Software approval is still a rather novel concept, and FAA has not formulated any guidelines to that end. There exist guidelines how to evaluate and approve a structural analysis, a wiring schematic/layout or an electrical load analysis, etc., but none have been developed for evaluation of software.

3. The following procedures are suggested to handle software:
   a) A description of the software is needed. This should not be a transcription into some computer language, a coded computer readout, a flow chart or a presentation of algorithms. It should be a sequential, functional description of what inputs together with what control functions will produce what output.

   b) The next step is to determine if the outputs listed above are correct in order to produce the intended function of the equipment. This may be accomplished by bench tests, flight tests or a combination of both.

c) The third step is to identify the software. This can best be done by means of a numbering method which defines the basic software configuration and any subsequent minor or major changes. A label, which calls out the installed software, should be affixed to the equipment. If the system contains a display readout which may be accessed by the flight crew, the software should be identified by display readout. Any peculiarities of the software, which may be of importance to the crew, will be listed in the AFM. Thus, it is very convenient for the crew to identify the software from the display readout and look up the peculiarities of that software in the AFM.

d) Approval of software is accomplished by call out on the Top Drawing, by enclosure of the software description (defined under a) above) in the data package, and by referral to approved software in the AFM.

AGENDA ITEM 6.5
AVIONICS COOLING

PROBLEM:

Considerations for providing proper avionics cooling (Reference enclosed item from AGL-255).

STATUS:

ACTION:

DISCUSSION: (Ref. Agenda Item 6.5a)

General discussion relative to current practices in the aircraft installation and compact stacking of solid state avionics: The associated performance effects and cooling problems require investigation. A review of current RTCA standards i.e., DO-60, DO-108, DO-138, and DO-160 was suggested, with appropriate revisions recommended. Information was provided, that ARINC currently in progress of a avionics cooling study. It was suggested that guidance material (AC) may be of value.

CONCLUSION:

AWS-343 to investigate the development of an AC for avionics cooling or inclusion of an item in 8600.1 and AC 43.13-1A by 6/80.

AGL-255

OFFICE: AGL-GADO-20, Ypsilanti, Michigan

SUBJECT: Avionics Cooling

BACKGROUND: In the new modern low current avionics equipment, which is not provided with a method of cooling, the radio repair stations are having problems heating these radios up to the operating temperatures that they are being exposed to in the aircraft. Some manufacturers have kits out to provide for avionics equipment cooling, but these kits are not mandatory to install.

RECOMMENDATIONS: It should be required that any aircraft manufacturer provide for proper avionics equipment cooling if they do the installation of the avionics package. If a repair station does the installation, they should be required to include a method of cooling the equipment and data for this should be in the manufacturer's installation instructions.

AGENDA ITEM 6.5a
DIGITAL EQUIPMENT COOLING

PROBLEM:

Proper avionics cooling requirements (Reference enclosed item from ANW-213).

STATUS:

ACTION.

DISCUSSION: (Ref. Agenda Item 6.5)

CONCLUSION:

No further action.

ANM-213

DIGITAL EQUIPMENT COOLING

Background:

Aeronautical Radio Incorporated (Arinc) has recently published a number of new characteristics dealing with digital avionics. Our initial discussions with airframe and equipment manufacturers indicate that this equipment may be more dependent on proper cooling air than existing communications and navigation equipment. The design of avionics cooling systems in current airplanes is not normally redundant except for cooling of inertial navigation systems. This can lead to the possibility of a single failure or probable combinations of failures which could cause the loss of all or almost all the flight instruments, communications, and navigation equipment.

Discussion:

Equipment which is designed to meet these new Arinc characteristics has not yet appeared on airplanes, but will be on the new Boeing 757/767 transports. The wording in these Arinc 700 series characteristics provides for normal equipment operation if a specified cooling airflow is provided and for a goal to minimize the reduction in equipment reliability if cooling air is lost. We are given to understand that the operating life of this type of equipment may be as low as 30 minutes if cooling air is lost.

Options:

1. Provide independent cooling systems for all required flight instruments, navigation, and communications equipment which needs cooling air for proper operation.

2. Provide a cooling air monitor to warn the crew that cooling has been lost and a landing should be made within "X" minutes.

3. Analyze each item of equipment to determine its expected life without cooling air. Require that this time is longer than the longest possible flight which the airplane could make.

4. Reject any required equipment which must have cooling air for proper operation.

Analysis of options:

1. Option 1 has been used for inertial navigation systems with good results to date, if independent cooling is provided to each unit and primary airflow is not dependent upon fans. Fans are used as the backup cooling airflow source, but their reliability is generally poor.

2. The time "X" is a variable depending upon the equipment design. It may not be possible to land within this time if the airplane is flown over water or in remote areas.

DIGITAL EQUIPMENT COOLING (Continued)

3. This option would permit the use of existing cooling system designs but would result in a degradation of reliability of the avionics equipment if a series of cooling failures were encountered.

4. This option appears to be too restrictive in light of satisfactory service experience of the INS.

Recommendations:

Use Option 1 and provide independent cooling to all required equipment which needs cooling air for proper operation if expected service life of this equipment is reduced by more than 50 percent when operated without cooling air.

ANW-213:JJTreacy:hm:x2500:9-27-79

AGENDA ITEM 6.6
COLOR STANDARDIZATION

PROBLEM:

Proliferation of color displays for weather radar, flight instruments, multi-purpose displays, etc. color standards consideration. (Reference enclosed letter from AWS-100 to RTCA)

STATUS:

ACTION:

DISCUSSION:

A general overview of the subject letter was provided, which indicated proposed actions by RTCA, SAE, NBS, and FAA. Also pointed to the fact that FAA is proposing that RTCA and/or SAE establish a subcommittee for electronic or multipurpose (multifunction) display MOPS considerations.

CONCLUSION:

No further action.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

May 4, 1979

Mr. Frank L. Jensen, Jr.
Chairman
Radio Technical Commission for Aeronautics
1717 H Street, N. W., Suite 655
Washington, D. C. 20006

Dear Mr. Jensen:

SUBJ: Color Standardization Considerations: Airborne Weather Radar/Air Traffic Control Displays, Airborne Multipurpose Displays, and Aircraft Instruments

We recommend that: 1) Radio Technical Commission for Aeronautics (RTCA) add a color standard task to the term of reference for SC 133, Airborne Weather and Ground Mapping Pulsed Radars; 2) Society of Automotive Engineers (SAE) also add a color standard task to committee A-4, Aircraft Instruments; and 3) RTCA, SAE, and National Bureau of Standards (NBS) coordinate their efforts in this matter with the Federal Aviation Administration (FAA). In view of the electronic display standards being developed by RTCA and the aircraft instrument standards under development by SAE, it appears that a uniform color standard which will encompass all types of displays is needed.

Digital airborne weather radar with multicolor Cathode Ray Tube (CRT) displays are now being produced by Bendix, RCA, etc., in ever growing quantities. "Multipurpose" color display applications, (i.e., radar information, electronic horizontal situation indicator, electronic attitude director indicator, area navigation, heads-up displays, cockpit display traffic information, etc.) are being introduced in derivative and new generation transport, business/general aviation aircraft, and rotorcraft. Advanced technology with improved system reliability, availability, and flexibility is allowing strong commitments to electronic displays and specifically color displays.

We are concerned in the "nonstandard" color applications in aircraft instruments and airborne weather radar displays. Confusion or misinterpretation may occur when a pilot is subjected to color variances between instruments or between aircraft with different vendor equipment.

This concern has recently been reinforced by the Air Traffic Service (ATS) who recognizes the potential color incompatibility between the airborne weather radar information and the air traffic control color display of the same storm cell. ATS is currently purchasing multiple color displays for weather information at all centers and various other facilities.

7.0 AIR CONDITIONING

(No Agenda Item Submitted. For Future Reference Only)

8.0 AUTO FLIGHT

AGENDA ITEM 8.1
AUTOPILOT AC 23.1329-1

PROBLEM:

The apparent need to re-issue the subject AC (Reference enclosed item from ACE-210).

STATUS:

ACTION:

DISCUSSION.

The cancellation resulted in field problems, when issuing TIA's for autopilots. Re-issue of the AC 23.1329-1 was recommended.

CONCLUSION.

AWS-160 will re-issue the AC by 1/18/80.

Priority 4 ACE-210

WICHITA EMDO-43 AGENDA ITEM

SUBJECT: Autopilot Advisory Circular AC 23.1329-1

BACKGROUND: Subject Circular has been cancelled.

OPTION: N/A

RECOMMENDATION: Re-issue

9.0 COMMUNICATIONS

AGENDA ITEM 9.1
DUAL VHF COMMUNICATIONS INTERFERENCE

PROBLEM:

Interference between dual VHF communication radio installations (Reference enclosed item from ANE-213).

STATUS:

ACTION:

DISCUSSION:

It was discussed by the ANE-213, that only the Collins 20A experienced the interference, not the King Transceivers on the S-76 helicopter. AWS-130 indicated that AAF-730 Frequency Management routinely assigned 500KC frequency separation assignments in the same service volume. On a regular basis they assign for high altitude 25KC but could assign 50KC separation assignments. They currently have 49 stations with 25KC assignments. AAF informal comments to 100KC to 900KC, is "totally unacceptable" (Investigations are in progress for future considerations of 12.5KC assignments).

CONCLUSION:

AWS-130 to solicit RTCA to establish an AD Hoc committee to investigate the subject problem by 2/80.

ANE-213

JOINT WORKSHOP DISCUSSION

SUBJECT : Interference Between Dual VHF Communication Radio Installations.

BACKGROUND: VHF radios may interfere with each other based on a number of factors; namely transmitter power, receiver sensitivity, distance between antennas and relative frequency settings of the two radio i.e., how close they are tuned to each other. On a large aircraft, the distance between antennas makes up for the other factors and precludes interference. Most small aircraft are single pilot and/or have a single audio control panel. With a single audio control panel only one communications radio can be used at a time so that interference is not a problem.

DISCUSSION: Many small transport helicopters have provisions for dual radios and dual intercommunications systems (ICS). Interference on these aircraft has manifested itself from simple low level crosstalk to high level distortion which completely overrides and blocks out all reception on the ICS. These aircraft are not of sufficient size to provide large separation between antennas; therefore, the other factors causing interference must be examined.

AVAILABLE OPTIONS :

1. Accept the ability to eliminate interference, after the antennas have been separated the maximum practical distance, as beyond the state-of-the-act.

2. Restrict, by flight manual or placards, the combinations of frequencies which cause interference.

3. Restrict the transmitter power and/or receiver sensitivity.

4. Interlock the radios so that only one radio can be used at a time.

ANALYSIS OF OPTIONS :

1. Unacceptable. Certification should be based on meeting minimum standards and not on the applicant's best shot. If interference is found acceptable for transport helicopters, then that same type of interference must be acceptable for transport airplanes.

2. Unacceptable from a pilot workload basis and the ability of the dual installation to meet its intended function.

3. If this option eliminates interference, it should be pursued by the applicant. It may require modifications to the radio equipment or it could prevent certain models of radio equipment from being eligible for installation of the aircraft.

4. Although this option would reduce the usefullness of a dual installation, it would provide an installation that meets its intended function and regulatory requirements.

RECOMMENDATIONS : The workshop should establish general guidelines for VHF-VHF communications interference. These general guidelines are recommended to be:

1. Some amount of low level crosstalk is acceptable based on whether or not it can cause an adverse effect. Adverse effect should be determined by the level of the crosstalk and the likelihood of occurrence.

2. High level crosstalk or distortion is not acceptable when the radios are tuned. .1MHz or more apart. It is common to have ground facilities. .3MHz to .6MHz apart and not unusual to be .1MHz apart. Therefore, .1MHz is a practical limit.

Submitted by:

R.L. Vavruska

RONALD L. VAVRUSKA, ANE-213E

AGENDA ITEM 9.2
AUDIO SYSTEMS INSTALLATIONS

PROBLEM:

The installation of stereo audio systems in aircraft (Reference enclosed item from ANW-252).

STATUS:

ACTION.

DISCUSSION:

The audiojack installation at the pilot/crew station would completely isolate the pilot/crew from communications with the ATC system. The attendee's believe this installation is totally unacceptable. Pilots noted that under FAR 91.10, one is not to operate the aircraft in a careless or reckless operation.

It was pointed out that Cessna & Bellanca have made such installations for their customers; as well as amateur radio installations are being made in various types of aircraft.

CONCLUSION.

AWS-343 to investigate relative to Part 91.10 and advise AFO-800 with regard to results of their investigations by 2/80.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ANW-252

DATE: June 22, 1979

FLIGHT STANDARDS DISTRICT OFFICE - 61
FAA Building, King Co. Int'l Airport
Seattle, Washington 98108

FEDERAL AVIATION ADMINISTRATION

IN REPLY REFER TO: NW-FSDO-61

SUBJECT: Agenda Items: Ref. AFS-833 letter, dtd 5/25/79: 1979 Systems Workshop; Regional Avionics Inspector/Specialist Participation

FROM: Frank V. Day, Principal General Aviation Avionics Inspector

TO: ANW-252

Agenda Item

1. The installation (including factory option) of AM/FM/Cassette/8 Track Audio Systems in aircraft, including a headphone jack for the pilot position. These units do not go through the aircraft audio system.

Concern: Knowing the automotive usage of the above equipment by the younger generation, I question the availability to the pilot of a headset emitting sound far above the level of any aural warning system and overriding any communication from ATC.

Frank V. Day

FRANK V. DAY

AGENDA ITEM 9.3
BEACON COLLISION AVOIDANCE SYSTEM

PROBLEM:

STC/field approvals of BCAS systems.

STATUS:

ACTION:

DISCUSSION:

AWS-130 provided a general overview of the BCAS efforts, including the STC application of Aerosonics in ASO, and an ARM application. The BCAS National Standard is not firm at this time, therefore, the agency is discouraging application/installation approvals.

CONCLUSION:

Agency policy will be formalized in a letter to Aerosonics. AWS-130 to provide a copy of the letter to all regions by 12/79.

DEC 27 1979

Mr. Joseph J. Brigati
Hill, Christopher and Phillips, P. C.
1900 M Street, N. W.
Washington, D. C. 20036

Dear Mr. Brigati:

This is in response to your letters regarding the Aerosonic Corporation request for information concerning its application for a Supplemental Type Certificate for a Beechcraft King Air equipped with a collision avoidance system, Aerosonic Model CAS-58AC.

Supplemental Type Certificates (STC's) in general are issued in accordance with the procedures set forth in Part 21 of the Federal Aviation Regulations (14 CFR Part 21). In addition, because of the developing nature of separation assurance type equipment, certain policy considerations also apply at this time. Under the policy described in this letter, STC's for aircraft incorporating such equipment may be issued in accordance with the provisions set forth below.

As you know, the FAA has issued a draft U.S. National Standard for the Active Beacon Collision Avoidance System (BCAS), published in the Federal Register December 21, 1978, (43 F.R. 59565). The FAA expects that there will be significant changes to the National Standard before it is adopted in final form. It appears that, at a minimum, active BCAS should coordinate commands between aircraft, have the same signal format, be compatible with the Discrete Address Beacon System, and the Automatic Traffic Advisory and Resolution Service, and that it have similar threat detection criteria and logic. Thus, until the BCAS standard is established, the FAA will not issue an STC for active BCAS.

However, the FAA policy provides that an STC may be issued for an aircraft meeting the regulations incorporated in the type certificate and equipped with a proximity warning device that does not meet the purpose, system description, or operational requirements of the proposed BCAS National Standard, if the device --

(1) Is not identified as a BCAS;

(2) Has no unsafe feature that could adversely affect compliance with operating rules, air traffic procedures, air traffic control system performance, or aircraft/pilot operational performance;

(3) Does not give maneuver advisories; and

(4) Performs its intended functions and meets all applicable airworthiness requirements pertaining to installed equipment.

It should be noted that after certification, if it is found that the Aerosonic equipment interferes with the proper operation of the ATC system, additional restrictions may be placed on its operation.

As explained in the preamble of the proposed National Standard, while an adopted National Aviation Standard describes one component subsystem of the National Airspace System and is not regulatory in nature, it may serve as the basis for subsequent rulemaking action. Such derivative rule making may include operating rules and certification standards covering airworthiness and performance requirements for equipment to be installed in aircraft. In this connection, it should be clearly understood that after the FAA adopts a U.S. National Aviation Standard for BCAS, the operating rules in the Federal Aviation Regulations may be amended to require certain operations to be conducted in aircraft which are equipped with active BCAS which meets the National Standard. If at that time the Aerosonic equipment does not meet, or could not be modified to meet, the adopted standard, complying equipment would have to be installed if the airplane is to be used in operations which require such equipment. It should be noted that the Aerosonic equipment may have to be removed, deactivated, or its use restricted. This can only be determined when a rule requiring BCAS is issued and equipment meeting the rule is evaluated in conjunction with the Aerosonic system.

Further discussions concerning the processing of the Aerosonic STC request should be held with:

Mr. Keith Blythe
Federal Aviation Administration
ASO-210
P.O. Box 20636
Atlanta, GA 30320
Telephone Number (404) 763-7428

The time necessary to process the application will depend on the complexity of the equipment and the schedule which the FAA Southern Region will be able to work out consistent with its workload

priorities. Since we have limited details of the Aerosonic equipment, it is not possible to state to what level the equipment must be tested. Accordingly, no firm time for completing action on the certification request can now be estimated.

I hope this information satisfies your concern regarding the Aerosonic request for STC.

Sincerely,

Original signed by
M. C. BEARD

M. C. BEARD
Director of Airworthiness

10.0 ELECTRICAL POWER

AGENDA ITEM 10.1
BATTERY BACKUP POWER - HELICOPTER

PROBLEM:

Helicopter IFR systems battery backup power requirement (Reference 1977 Agenda Item 14 and enclosed item from AEU-100).

STATUS:

There is a rotorcraft Part 27/29 review that may pick up this item.

ACTION:

AWS-130 submitted a proposal to the Rotorcraft Regulatory Review Program. Status will be given at workshop.

DISCUSSION:

AWS-130 presented an overview of the subject requirement and generally reviewed the AEU-100 agenda item. The AWS-130 regulatory proposal was reviewed, and will be provided.

In retrospect, it is deemed important that the regions provide information on what electrical system configurations have been approved and what was basis for approval.

CONCLUSION:

AWS-130 to provide a copy of the regulatory proposal by 12/79. Request the regions survey installations approved and provide information to AWS-130 by 2/80.

AEU-100

1979 Systems Workshop

AEU-100

4. SUBJECT · Electrical System Configurations complying with current FAR-23 and FAR-29 requirements.

BACKGROUND:

On recent FAR-23 through amendment 23-17 FAR 29 certification programs where there is a requirement for dual systems, AEU-100 has required electrical system integrity/electrical isolation when considering single faults to ground on the distribution system. Although credit has been requested, no compliance credit has been given toward considering the aircraft battery as an emergency power source.
Design changes were made to show system independence under single fault criteria.

DISCUSSION:

Where the certification basis includes through amendments 23-17 or in certificating to FAR-29, what electrical configurations have been approved by the FAA Regions. If single busses have been approved since the 1975 system Workshop what was the basis for approval?

RECOMMENDATION: Minutes of this workshop will suffice.

Proposal:
From: AFS-130
Index:
FAR: 27.1351 (f) (New)
Subject: Electrical Systems and Equipment for IFR

Proposal	Current Rule
By adding a new § 27.1351(f) to read as follows:	None

§ 27.1351 General.

* * * * *

(f) <u>Standby battery IFR power source.</u> There must be a standby battery power source with the capacity (in a primary electrical failure) to power:

(1) An independent attitude indicator;

(2) A single NAVCOM transceiver;

(3) Critical instrument lights; and

(4) The essential trim systems to touchdown.

Standby battery(s) may be changed from the rotorcraft electrical system if adequate isolation is provided.

EXPLANATION AND JUSTIFICATION

Rotorcraft certificated for operation under Instrument Flight Rules (IFR) must provide the capability to make a safe touchdown from maximum IFR operational altitude after a total systems failure.

Proposal:
From: AFS-130
Index:
FAR: 29.1351 (f) (New)
Subject: Electrical Systems and Equipment for IFR

Proposal	Current Rule
By adding a new § 29.1351(f) to read as follows:	None

§ 29.1351 General.

* * * * *

(f) Standby battery IFR power source. There must be a standby battery power source with the capacity (in a primary electrical failure) to power:

(1) An independent attitude indicator;

(2) A single NAVCOM transceiver;

(3) Critical instrument lights; and

(4) The essential trim systems to touchdown.

Standby battery(s) may be changed from the rotorcraft electrical system if adequate isolation is provided.

EXPLANATION AND JUSTIFICATION

Rotorcraft certificated for operation under Instrument Flight Rules (IFR) must provide the capability to make a safe touchdown from maximum IFR operational altitude after a total systems failure.

AGENDA ITEM 10.2
AIRCRAFT ELECTRICAL SYSTEMS

PROBLEM.

Aircraft electrical system compatibility with TSO equipment it is powering (Reference enclosed item from AGL-255).

STATUS.

ACTION.

DISCUSSION

A general discussion of the aircraft electrical system compatibility vs the TSO equipment specified input requirements were conducted. It appears prudent to determine (if possible) electrical system performance/cleaniness with aircraft manufacturer's and repair stations.

Note. There is no intent to require ±2% input voltage control for TSO equipment. ±2% value is for bench test equipment tolerances.

CONCLUSION.

AWS-343 to review 43.13-1A and contact AEA for problem definition by 1/80.

AGL-255

OFFICE: AGL-GADO-20, Ypsilanti, Michigan

SUBJECT: Aircraft Electrical Systems

BACKGROUND: Avionics' TSOs require that the equipment perform to specification with some specified input voltage. For so called "12 volt equipment", the typical specified input voltage is 13.75 volts ±2%; therefore, the equipment should perform as advertised as long as the input voltage is between 13.475 volts and 14.025 volts.

Aircraft electrical systems using automotive type voltage regulators have a permissible range which is typically 13.0 volts to 15.5 volts. Considering this, it is amazing that the avionics gear works at all.

System performance indication is another serious problem. "Generator Out" lights and ammeter load meters can only indicate gross malfunction. This affords the pilot little, if any, forewarning of failure. A sensitive indication that the system was performing within the TSO limits of the equipment it is powering would be more meaningful.

The existence of these problems, coupled with the minimal inspection requirements for aircraft electrical systems, does effect the safety of flight. None of us would care to be IFR at night in a blacked-out, unguided, lost aircraft.

RECOMMENDATIONS: The aircraft electrical system must be designed and maintained to be compatible with the TSO equipment it is powering. The FAA should tighten up the tolerances on the aircraft electrical system. During the aircraft annual inspection, the FAA should require a rigorous performance check of the electrical system. As a minimum the following should be required on an annual inspection:

1. Using an oscilloscope or a reliable meter measure peak to peak (ripple) voltage on the D.C. buss to detect the following:

    a. Open or shorted diodes in alternator.

    b. Shorted winding in alternator/generator.

    c. Poor brush contact in alternator/generator.

2. Repeat Step 1, turning on and off one piece of equipment at a time, including intermittent loads to detect any piece of equipment placing excessive repetitive and/or non-repetitive transients on the buss.

3. Monitor buss with a precision voltmeter, operate engine at cruise RPM, turn on one piece of equipment at a time to check for proper voltage regulation operations plus or minus 2% of proper voltage.

4. Check battery for specific gravity and cell balance to manufacturer's specifications.

Subject: Aircraft Electrical Systems; Recommendations con't

5. Check multiengine aircraft for even electrical load distribution.

AGENDA ITEM 10.3
LITHIUM BATTERIES

PROBLEM:

ELT battery corrosion, violent venting, explosion, etc. (Reference 1977 Agenda Item 14 and enclosed items from AGL-255 & AEA-213).

STATUS.

AWS-130 has issued an AD to remove Lithium batteries from aircraft. AWS-130 has also issued a TSO NPRM on lithium sulfur dioxide batteries for comments.

ACTION:

AD and TSO NPRM currently in progress.

DISCUSSION.

A general review of the subject problem was conducted. The AD, TSO, and AWS-100 policy letter were reviewed. An applicant has approached the FAA for possible approval of a Lithium Bromide Complex Battery. The applicants have been advised to review TSO C-97 specification for LISO2, review their test procedures and design specifications and propose a specification to an industry group i.e., RTCA, SAE, etc. Questions regarding disposition of batteries removed from aircraft was addressed, as a quantity of batteries have exploded after removal. It was suggested that removed batteries be located in an area outside of human habitation.

CONCLUSION:

AWS-130 to provide a copy of the policy letter, AD, and TSO by 12/79. An "Alert" for disposition will be issued by AWS-130 by 12/79.

AGL-255

SUBJECT: ELT battery corrosion resulting in transmitter inadvertent activation or complete failure:

BACKGROUND: There has been more problems with ELTs in this area than in any other part of the ELT. It is not unusual to get several reports per month of inadvertent activations and to receive several M or D reports per week of corroded batteries.

DISCUSSION: The manufacturer of the battery specifies the life of the battery. FAA states in part that when the battery installed in the ELT looses 50% of its life, the battery will be removed and replaced. Battery life expectancy is not being realized. They are not lasting the expected or published time.

RECOMMENDATION: Since batteries are the greatest problem area in ELTs, a reevaluation of the TSO may be in order. Frequent inspections will uncover a start of battery corrosion allowing the condition to be corrected before other problems arise. However, this is a burden for both the operator and mechanic doing the inspection. Better design criteria would improve ELT quality and reliability and eliminate frequent inspections. It appears that there are vast variances in the operational capabilities of all ELTs manufactured under the TSO.

AEA-213

Systems only

Subject: Approval of lithium batteries which are not lithium, sulphur dioxide type

Background: There are new types of lithium batteries which are not lithium sulphur dioxide batteries. However, they have the detrimental characteristics of LI SO_2 batteries, that is, venting and corrosion. One variety of these batteries are lithium thionyl chloride batteries.

Discussion: The lithium sulphur dioxide batteries are used primarily in ELT units because of their good performance in low temperature and their high energy/weight ratio. The FAA has found it necessary to issue an Airworthiness Directive to remove all these batteries from aircraft due to their corrosive emission of toxic gases and their affect on the aircraft and ELT reliability. The FAA has issued an NPRM (TSO-C95) for the qualification of lithium sulphur dioxide batteries. There are, however, new type lithium batteries that are being proposed for use in ELTs and on aircraft. One of these types are lithium thionyl chloride.

Available Options:

1. Prevent the installation of these batteries on aircraft and specifically in ELT's.

2. Use proposed TSO-C95 as a guide to qualify these batteries. This would mean amending the proposed TSO to include tests for these and other type lithium batteries.

Analysis of Options:

1. Since we are permitting the installation on aircraft of lithium sulphur dioxide batteries which will meet the proposed TSO-C95, we will find it difficult to prevent the installation of lithium thionyl chloride batteries.

2. Proposed TSO-C95 can be amended to include qualification of the various lithium type batteries using tests which can be applicable for all lithium batteries.

Recommendation:

Amend proposed TSO-C95 to put in general tests which can be applied to any type of lithium battery in order to assure that we will not create the same problem which created the issuance of AD 79-05-02.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1978 — 621 - 180

JUL 25 1979

AFS-130

Lithium Thionyl Chloride Batteries; AEA-200 (AEA-213) letter dated 5/1

Chief, Engineering, and Manufacturing Division, AFS-100

AEA-200

We are not sure if lithium thionyl chloride batteries and lithium sulfur dioxide ($LiSO_2$) batteries exhibit the same characteristics. There is some evidence that lithium thionyl chloride batteries are, in fact, safer than $LiSO_2$ batteries. However, the U.S. military services have experienced some problems with lithium thionyl chloride batteries. The recommendation at a recent interagency lithium battery safety group meeting was that it is premature to introduce lithium thionyl chloride batteries. These batteries are still in a developmental stage, and there are uncertainties in their performance and safety. Therefore, we feel that there should be no authorization for the use of lithium thionyl chloride batteries until appropriate standards are developed.

Original signed by:
R. G. Horeff

JAMES O. ROBINSON

cc:AFS-130/100/All Regions
AFS-131;P.Neuman:kb:68395:7/13/79
MC AFS-100;5/1/79 SUS;5/18/79
File No. 8100 37 A

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14 CFR Part 39

[Docket No. 18734; Amdt. 39-3549]

Lithium Sulfur Dioxide Batteries

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This amendment supersedes an existing airworthiness directive (AD), applicable to all Lithium Sulfur Dioxide ($LiSO_2$) batteries installed in aircraft or in equipment used in aircraft, which required removal of all $LiSO_2$ batteries and Emergency Locator Transmitters (ELT) powered by such batteries. This amendment adopts a new AD which requires either reinstallation of ELT's powered by $LiSO_2$ batteries which meet new standards or installation of another ELT powered by another source. The AD requires the removal from aircraft of any $LiSO_2$ batteries which do not meet the new standards and any ELT's powered by such batteries. It also extends the period to time in which aircraft from which an ELT has been removed in accordance with these AD's may be operated without the required ELT.

DATES: Effective—August 24, 1979.

Compliance is required as indicated in body of AD.

FOR FURTHER INFORMATION CONTACT: Mr. Adolfo O. Astorga, Systems Branch, Aircraft Engineering Division, Office of Airworthiness, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591: Telephone (202) 426-8395.

SUPPLEMENTARY INFORMATION: Amendment 39-3422 (44 FR 10980; February 26, 1979), AD 79-05-02 required removal of all $LiSO_2$ batteries from U.S.-registered civil aircraft and the removal of all ELT's powered by $LiSO_2$ batteries installed in U.S.-registered civil aircraft. It further provided that notwithstanding FAR § 91.52, aircraft from which an ELT had been removed to comply with the AD would be permitted to operate for a period of 180 days without the ELT. This AD was prompted by reports of $LiSO_2$ batteries exploding, venting violently, corroding, burning, and leaking gas.

Since issuing Amendment 39-3422, AD 79-05-02, the FAA has issued TSO-C97 which sets forth the requirements which must be met for TSO approval of $LiSO_2$ batteries. This Technical Standard Order (TSO), FAR § 37.209, was published in the **Federal Register** on August 27, 1979.

This amendment adopts a new AD which requires removal from U.S.-registered civil aircraft of all $LiSO_2$ batteries which do not meet the requirements of TSO-C97 and all ELT's powered by such batteries. It also requires that before March 28, 1980 in those aircraft from which ELT's were removed in accordance with AD 79-05-02 or this AD that either (1) $LiSO_2$ batteries which meet the requirements of TSO-C97 be installed in the ELT and the ELT be reinstalled on the aircraft or (2) that another ELT powered by a source other than $LiSO_2$ batteries be installed in the aircraft. In either case, the ELT must meet the requirements of FAR § 37.200. Further, it requires that this action be recorded in the aircraft records and that the "ELT not installed" placard be removed. In addition, the AD extends until March 28, 1980 the period in which an aircraft from which an ELT has been removed to comply with AD 79-05-02 or this AD may be operated without the ELT required by FAR §§ 91.52(a) and (b).

The temporary extension is being provided to allow time for the testing, TSO authorization, manufacture, and distribution of $LiSO_2$ batteries that meet the requirements of TSO-C97. However, it should be noted that there is no certainty that $LiSO_2$ batteries that meet the TSO requirements will be manufactured and commercially available. Thus, before March 28, 1980, it may be necessary for some aircraft owners to replace ELT's that were originally powered by $LiSO_2$ batteries. Other equipment may be required to be modified to use other power sources if $LiSO_2$ batteries are not available.

Since a situation exists that requires the immediate adoption of this regulation, it is found that notice and public procedure hereon are impracticable and good cause exists for making this amendment effective in less than 30 days.

Adoption of Amendment

Accordingly, pursuant to the authority delegated to me by the Administrator, § 39.13 of Part 39 of the Federal Aviation Regulations (14 CFR 39.13) is amended effective Aug. 24, 1979 by adding the following new airworthiness directive:

Lithium Sulfur Dioxide Batteries. Applies to all Lithium Sulfur Dioxide ($LiSO_2$) batteries installed in aircraft or in equipment used in aircraft.

$LiSO_2$ batteries have been used in, but not necessarily limited to, the following Emergency Locator Transmitters (ELT's):

Communications Components Corp.

Model CIR 10, all serial numbers
Battery pack BP-61, BP-61A, BP-60B, and BP-60C
Model CIR 11-2, all serial numbers
Battery pack BP-30-11, BP-40-11A, BP-40-11B, and BP-40-11C

Cessna Aircraft Co.

Part Number C589510-0103
Part Number C589510-0205
Part Number C589510-0208
Part Number C589510-0212

Dorne & Margolin

Model DMELT 5 serial number 1 to 24,999 with battery pack DMELT 6.11, except those ELT's which have been modified by the change to battery pack DMELT 6.13

Garrett

Model No. 827-816—all serial numbers
Model No. 827-818—all serial numbers
Model No. 827-820—all serial numbers
Model No. 625-166—all serial numbers
Battery part number—016-249-1, 016-249-2

Leigh

Model SHARC 7 with a 3 or 4 cell battery pack. The ELT including battery weighs approximately 1.6 pounds.

Pathfinder

Model No. 2253

Pointer

Model 3000
Model 2000, Series Mod A
Model 3000, Series Mod A
Model 3000-2
$LiSO_2$ battery pack—P/N 2018, P2016, M2016, 2018 HSP, and 2018 HSM

Other aircraft equipment that have used $LiSO_2$ batteries:

(1) Bendix RNAV Computer Model RNS3500 Control Display Unit CD-3501A.

(2) Emergency lighting, sliderafts, and flashlights.

Manufacturers have not used $LiSO_2$ batteries in the following ELT's. However, such batteries may have been substituted after manufacture.

Pacific Communication Corp.

Alert Model 50, 60, & 70

Pacific Avionic Co., Inc

Model ELT-1

DME Corp.

Model RLB-5 (A)
Model RLB-9 (A) and (B)

Micro Electronics

Emergency Beacon Corp.

All models

LARAGO/MERL, Inc.

LARAGO 79007
MERL 1005

Dorne and Margolin

Model DMELT 5 serial no. 25,000 & above

Compliance is required as indicated, unless already accomplished.

To prevent fire, venting violently, explosion, corrosion, or leakage of gas associated with certain $LiSO_2$ batteries, accomplish the following:

(a) Before further flight, remove all $LiSO_2$ batteries which do not meet the requirements of TSO-C97 from U.S.-registered civil aircraft, including any installed in equipment used in such aircraft.

(As published in the Federal Register (44 FR 50321) on August 27, 1979.)

Note.—This AD requires that $LiSO_2$ batteries used in U.S.-registered civil aircraft meet the requirements of TSO–C97. $LiSO_2$ batteries removed from equipment in accordance with AD 79–05–02 or this AD may be replaced by $LiSO_2$ batteries which meet the requirements of TSO–C97 or another power source. However, in either case the equipment must meet all applicable requirements of the Federal Aviation Regulations.

(b) Before further flight, remove from U.S.-registered civil aircraft any ELT powered by $LiSO_2$ batteries which do not meet the requirements of TSO–C97, and comply with the recordkeeping and placarding requirements of FAR § 91.52(f)(10)(i).

(c) For any aircraft from which an ELT has been removed to comply with AD 79–05–02 or this AD, before March 28, 1980, either—

(1) Install $LiSO_2$ batteries which meet the requirements of TSO–C97 in the ELT and, provided the ELT meets the requirements of FAR § 37.200, reinstall it in the aircraft; or

(2) install in the aircraft an ELT which meets the requirements of FAR § 37.200 which is powered by a source other than $LiSO_2$ batteries.

(d) Upon installation of an ELT in accordance with paragraph (c) of this AD, record in the aircraft records the action taken, and remove the placard which states "ELT not installed".

(e) Notwithstanding FAR § 91.52(f)(10)(ii), an aircraft from which an ELT has been removed in accordance with AD 79–05–02 or this AD, may operate without an ELT required by FAR §§ 91.52 (a) and (b) until complying with paragraph (c) of this AD but in no event later than March 28, 1980.

Note.—No further extensions of the period of time in which an aircraft may operate without an ELT installed will be granted. It should be noted that this extension allows aircraft operation without ELT's during the severe conditions of the winter months. Especially for those persons who operate in remote areas where cold temperatures are common, it is recommended that another approved power source be substituted until $LiSO_2$ batteries meeting TSO–C97 become available. The ELT manufacturers should be contacted directly to ascertain the availability of non-$LiSO_2$ battery power sources. If alternative power sources are not available a temporary replacement ELT should be considered. These comments should not be interpreted as promoting the permanent use of non-$LiSO_2$ powered ELT's since $LiSO_2$ batteries offer superior performance in cold temperatures. The FAA's concern is that during the next winter those persons who will most likely benefit from an ELT have one installed in their aircraft.

Within 3 months after the adoption of this AD the FAA expects to have definitive information on whether or not batteries that meet TSO–C97 can be manufactured. If it becomes apparent that $LiSO_2$ batteries that are safe for aviation will not be available, the FAA will advise the public on the necessity of replacing $LiSO_2$ battery-powered ELT's. This information will be made available in time to allow such replacements before March 28, 1980.

This supersedes Amendment 39–3422, AD–79–05–02.

This amendment becomes effective August 24, 1979.

(Secs. 313(a), 601, 603 Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, and 1423); Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); 14 CFR 11.89)

Note.—The FAA has determined that this document involves a regulation which is not considered to be significant under the procedures and criteria prescribed by Executive Order 12044 and implemented by the Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979).

Issued in Washington, D.C. on August 23, 1979.

James O. Robinson,

Acting Director, Office of Airworthiness.

[FR Doc. 79–26458 Filed 8–24–79; 8:45 am]

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Title 14 - Aeronautics and Space

CHAPTER I - FEDERAL AVIATION ADMINISTRATION
DEPARTMENT OF TRANSPORTATION

(Docket No. 18734; Amdt. 39-~~3449~~) 3549)

LITHIUM SULFUR DIOXIDE BATTERIES

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This amendment supersedes an existing airworthiness directive (AD), applicable to all Lithium Sulfur Dioxide (Li SO_2) batteries installed in aircraft or in equipment used in aircraft, which required removal of all Li SO_2 batteries and Emergency Locator Transmitters (ELT) powered by such batteries. This amendment adopts a new AD which requires either reinstallation of ELT's powered by Li SO_2 batteries which meet new standards or installation of another ELT powered by another source. The AD requires the removal from aircraft of any Li SO_2 batteries which do not meet the new standards and any ELT's powered by such batteries. It also extends the period of time in which aircraft from which an ELT has been removed in accordance with these AD's may be operated without the required ELT.

DATES: Effective - August ~~27~~ 24, 1979.

Compliance is required as indicated in body of AD.

FOR FURTHER INFORMATION CONTACT:

Mr. Adolfo O. Astorga, Systems Branch, Aircraft Engineering Division, Office of Airworthiness, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591; Telephone (202) 426-8395.

SUPPLEMENTARY INFORMATION:

Amendment 39-3422 (44 FR 10980; February 26, 1979), AD 79-05-02 required removal of all Li SO_2 batteries from U.S.-registered civil aircraft and the removal of all ELT's powered by Li SO_2 batteries installed in U.S.-registered civil aircraft. It further provided that notwithstanding FAR § 91.52, aircraft from which an ELT had been removed to comply with the AD would be permitted to operate for a period of 180 days without the ELT. This AD was prompted by reports of Li SO_2 batteries exploding, venting violently, corroding, burning, and leaking gas.

Since issuing Amendment 39-3422, AD 79-05-02, the FAA has issued TSO-C97 which sets forth the requirements which must be met for TSO approval of Li SO_2 batteries. This Technical Standard Order (TSO), FAR § 37.209, was published in the FEDERAL REGISTER on August 27, 1979.

This amendment adopts a new AD which requires removal from U.S.-registered civil aircraft of all Li SO_2 batteries which do not meet the requirements of TSO-C97 and all ELT's powered by such batteries. It also requires that before March 28, 1980 in those aircraft from which ELT's were removed in accordance with AD 79-05-02 or this AD that either 1) Li SO_2 batteries which meet the requirements of TSO-C97 be installed in the ELT and the ELT be reinstalled on the aircraft or 2) that another ELT powered by a source other than Li SO_2 batteries be installed in the aircraft. In either case, the ELT must meet the requirements of FAR § 37.200. Further, it requires that this action be recorded in the aircraft records and that the "ELT not installed" placard be removed. In addition, the AD extends until March 28, 1980 the period in which an aircraft from which an ELT has been removed to comply with AD 79-05-02 or this AD may be operated without the ELT required by FAR §§ 91.52(a) and (b).

The temporary extension is being provided to allow time for the testing, TSO authorization, manufacture, and distribution of Li SO_2 batteries that meet the requirements of TSO-C97. However, it should be noted that there is no

certainty that Li SO_2 batteries that meet the TSO requirements will be manufactured and commercially available. Thus, before March 28, 1980, it may be necessary for some aircraft owners to replace ELT's that were originally powered by Li SO_2 batteries. Other equipment may be required to be modified to use other power sources if Li SO_2 batteries are not available.

Since a situation exists that requires the immediate adoption of this regulation, it is found that notice and public procedure hereon are impracticable and good cause exists for making this amendment effective in less than 30 days.

ADOPTION OF AMENDMENT

Accordingly, pursuant to the authority delegated to me by the Administrator, § 39.13 of Part 39 of the Federal Aviation Regulations (14 CFR 39.13) is amended by adding the following new airworthiness directive:

LITHIUM SULFUR DIOXIDE BATTERIES. Applies to all Lithium Sulfur Dioxide (Li SO_2) batteries installed in aircraft or in equipment used in aircraft.

Li SO_2 batteries have been used in, but not necessarily limited to, the following Emergency Locator Transmitters (ELT's):

Communications Components Corporation

Model CIR 10, all serial numbers

Battery pack BP-60, BP-60A, BP-60B, and BP-60C

Model CIR 11-2, all serial numbers

Battery pack BP-60-11, BP-60-11A, BP-60-11B, and BP-60-11C

Cessna Aircraft Co.

Part Number C589511-0103

Part Number C589510-0202

Part Number C589510-0209

Part Number C589510-0109

Dorne and Margolin

Model DMELT 6 serial number 1 to 24,999 with battery pack DMELT 6.11, except those ELT's which have been modified by the change to battery pack DMELT 6.13.

Garrett

Model No. 627-810- all serial numbers

627-818- all serial numbers

627-934- all serial numbers

625-088- all serial numbers

Battery part number

616-246-1

616-246-2

Leigh

Model SHARC 7 with a 3 or 4 cell battery pack. The ELT including battery weighs approximately 1.8 pounds.

Pathfinder

Model No. 2052

Pointer

Model 2000

Model 2000, Series Mod A

Model 3000, Series Mod A

Model 3000-2

Li SO_2 battery pack - P/N 2018, P2018, M2018, 2018 HSP, and 2018 HSM

Other aircraft equipment that have used Li SO_2 batteries:

1) Bendix RNAV Computer Model RNS3500 Control Display Unit CD-3501A.
2) Emergency lighting, sliderafts, and flashlights.

Manufacturers have not used Li SO_2 batteries in the following ELT's. However, such batteries may have been substituted after manufacture.

Pacific Communication Corp.

Alert Model 50, 60, & 70

Pacific Avionic Co., Inc.

Model ELT-1

DME Corp.

Model RLB-5 (A)

Model RLB-9 (A) and (B)

Micro Electronics

Emergency Beacon Corp.

All models

LARAGO/MERL, Inc.

LARAGO 79007

MERL 1005

Other aircraft equipment that have used Li SO_2 batteries:

1) Bendix RNAV Computer Model RNS3500 Control Display Unit CD-3501A.

2) Emergency lighting, sliderafts, and flashlights.

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Emergency Beacon Corp.

All models

LARAGO/MERL, Inc.

LARAGO 79007

MERL 1005

Dorne and Margolin

Model DMELT 6 serial no. 25,000 & above

Compliance is required as indicated, unless already accomplished.

To prevent fire, venting violently, explosion, corrosion, or leakage of gas associated with certain Li SO_2 batteries, accomplish the following:

(a) Before further flight, remove all Li SO_2 batteries which do not meet the requirements of TSO-C97 from U.S.-registered civil aircraft, including any installed in equipment used in such aircraft.

NOTE - This AD requires that Li SO_2 batteries used in U.S.-registered civil aircraft meet the requirements of TSO-C97. Li SO_2 batteries removed from equipment in accordance with AD 79-05-02 or this AD may be replaced by Li SO_2 batteries which meet the requirements of TSO-C97 or another power source. However, in either case the equipment must meet all applicable requirements of the Federal Aviation Regulations.

(b) Before further flight, remove from U.S.-registered civil aircraft any ELT powered by Li SO_2 batteries which do not meet the requirements of TSO-C97,

and comply with the recordkeeping and placarding requirements of FAR § 91.52(f)(10)(i).

(c) For any aircraft from which an ELT has been removed to comply with AD 79-05-02 or this AD, before March 28, 1980, either -

(1) Install Li SO_2 batteries which meet the requirements of TSO-C97 in the ELT and, provided the ELT meets the requirements of FAR § 37.200, reinstall it in the aircraft; or

(2) Install in the aircraft an ELT which meets the requirements of FAR § 37.200 which is powered by a source other than Li SO_2 batteries.

(d) Upon installation of an ELT in accordance with paragraph (c) of this AD, record in the aircraft records the action taken, and remove the placard which states "ELT not installed".

(e) Notwithstanding FAR § 91.52(f)(10)(ii), an aircraft from which an ELT has been removed in accordance with AD 79-05-02 or this AD, may operate without an ELT required by FAR §§ 91.52(a) and (b) until complying with paragraph (c) of this AD but in no event later than March 28, 1980.

NOTE - No further extensions of the period of time in which an aircraft may operate without an ELT installed will be granted. It should be noted that this extension allows aircraft operation without ELT's during the severe conditions of the winter months. Especially for those persons who operate in remote areas where cold temperatures are common, it is recommended that another approved power source be substituted until Li SO_2 batteries meeting TSO-C97 become available. The ELT manufacturers should be contacted directly to ascertain the availability of non-Li SO_2 battery power sources. If alternative power sources are not available a temporary replacement ELT should be considered. These comments should not be interpreted as promoting the permanent use of non-Li SO_2 powered ELT's since Li SO_2 batteries offer superior performance in cold temperatures. The FAA's concern is that during the next winter those persons who will most likely benefit from an ELT have one installed in their aircraft.

Within 3 months after the adoption of this AD the FAA expects to have definitive information on whether or not batteries that meet TSO-C97 canbe manufactured. If it becomes apparent that Li SO_2 batteries that are safe for aviation will not be available, the FAA will advise the

public on the necessity of replacing Li SO_2 battery-powered ELT's. This information will be made available in time to allow such replacements before March 28, 1980.

This supersedes Amendment 39-3422, AD-79-05-02.

This amendment becomes effective August ~~25~~ 24, 1979.

(Secs. 313(a), 601, 603 Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, and 1423); Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); 14 CFR 11.89).

NOTE - The FAA has determined that this document involves a regulation which is not considered to be significant under the procedures and criteria prescribed by Executive Order 12044 and implemented by the Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979).

James O. Robinson

JAMES O. ROBINSON
Acting Director
Office of Airworthiness

Issued in Washington, D. C. on AUG 23 1979

12.0 FIRE PROTECTION

AGENDA ITEM 12.1
FIRE EXTINGUISHER AGENT HALON 1211

PROBLEM:

The use of fire extinguisher agent HALON 1211 in aircraft standards (Reference enclosed item from ACE-210).

STATUS:

ACTION:

DISCUSSION:

The ACE-210 agenda item was reviewed, and solicitation made relative to possible adverse service experience records within any region. Halon 1211 is available and Halon 1301 is not available.

AWS-120 has primary responsibility for fire extinguishers, and have initiated a 9550 project for hand-held fire extinguishers. Based on results of project, AC 20-42 will be revised.

CONCLUSION:

AWS-130 to provide draft AC (from AWS-120) when available in 1980.

ACE-210

ENGINEERING & MANUFACTURING BRANCH

SUBJECT: Use of Fire Extinguisher Agent Halon 1211 in Aircraft Cabins

BACKGROUND: Halon 1211 is being used in hand fire extinguishers on all types of aircraft. Because of its toxic properties, the small aircraft cabin volume, and its decomposing characteristics, the concentration b· volume and time of exposure may exceed the safe level ..r humans.

FACTS BEARING ON THE PROBLEM:

1. National Fire Codes, Volume One, 1975, section A-1200, shows that studies of Halon 1211 effects on humans have found exposures to concentrations below four percent for one minute produces minimal effects on the central nervous system.

2. Air Force Report No. AMRL-TR-74-143, dated November 1974, shows 1.2% as being a safe concentration of Halon 1211 for three to five minutes of exposure.

3. A May 3, 1977, letter from Paul W. Smith, Ph.D., Chief Aviation Toxicology Laboratory, AAC-114, states, "Unless the concentration of 1211 which will suppress fire is extremely low (perhaps well below 1%), I believe we would be on very uncertain ground to approve its use."

4. Underwriters' Laboratories Classification of Comparative Life Hazard of Various Chemicals places Halon 1211 in the 5a group.

5. Advisory Circular AC 20-42, paragraph 3.e., shows that hand fire extinguishers that use an extinguishing agent that has a rating in the toxicity group 5 or higher are acceptable under FAR 25.851(a)(3).

6. Many airframe manufacturers are using Halon 1211 hand extinguishers. Beechcraft Report ER E23135 shows that three other FAR 23 and two FAR 25 manufacturers are using this type of hand extinguishers.

DISCUSSION: There are no known acceptable standards for the use of Halon 1211. The documents cited above do in fact tend to contradict each other and thus lead to confusion as to what is an acceptable level of concentration of this agent. If the level of 4% for 1 minute (National Fire Code, Volume One) is followed and a 4% time exposure is accepted, then .8% for 5 minutes would become the acceptable level. This

would be a lower concentration than that shown in report AMRL-TR-74-143 and would be consistent with Dr. Smith's position that the concentration should be below 1%. Establishing a concentration level limitation of this type is not consistent with Underwriters' classification of this agent as being in group 5a and AC 20-42 which shows that group 5 and 6 agents meet FAR 25 requirements. Airframe manufacturers have interpreted the Underwriters' classification and the AC to mean that they may put one or two extinguishers on their airplanes with no need to consider concentration levels or venting needed to reduce the concentration. They appear to have ignored the fact that tests have shown that exposure to concentration above 4% for a one-minute exposure results in dizziness, impaired coordination and reduced mental acuity. Should a pilot suffer these effects the results could be hazardous. It should also be noted that at higher concentrations of this agent (5% to 10%) there is a risk of unconsciousness and possible death if exposure is prolonged.

In addition to the above discussed problems regarding safe concentrations of undecomposed Halon 1211 there is also a need to evaluate the effects of the decomposition of this agent when it is applied to a fire. Information available shows that when this agent is exposed to temperatures of 900°F in the presence of hydrogen from water vapor or from the combustion process itself, the resulting main decomposition products are halogen acids (HF, HCI, HBr) and free halogens (Cl_2, Br_2). Some sources feel that these products of the decomposition, along with the small amount of generated carbonyl halides (COF_2, $COCI_2$, $COBr_2$) are more of a hazard to occupants of an aircraft than the agent itself.

On April 7, 1977, the Central Region's letter to Beech Aircraft Corporation advised them that we proposed that the safe concentration of 1.2% for a three to five minute exposure established by report AMRL-TR-74-143 be used and by a copy of that letter to AFS-120 proposed revising AC 20-42 to include that criteria. In that same letter we recommended that they consider the highest concentration possible from a completely discharged bottle in a non-ventilated, fully occupied cockpit and cabin.

<u>OPTIONS:</u> N/A

<u>RECOMMENDATION:</u> Initiate a project to provide criteria for the use of Halon 1211 and distribute this criteria to all concerned. This project should consider types of fires that service

history has sh[illegible] are likely to occur, so that the combination [illegible]ts of undecomposed and decomposed agents can be considered. If this project shows that conditions that are unsafe for the occupants are likely to result [illegible]m the discharge of this agent, provide your recommendation for correcting these conditions.

R, D & E EFFORT REQUEST	PERSON MOST FAMILIAR WITH REQUEST NAME: Henri P. Branting	RTG. SYM: AWS-120	EXT: X68382

PART I	INSTRUCTIONS To be completed by initiating region or center, which will insert the routing symbol of the responsible headquarters program office or service in Part II, or by originating headquarters program office or service.

REQUEST SUBJECT
Hand-Held Fire Extinguishers for Aircraft Cabins

REQUEST NUMBER

REQUIREMENT (Make statement in mission terms, NOT equipment terms)

Background: Advisory Circular AC 20-42 (copy enclosed) was developed in 1965 to complement airworthiness standards on hand fire extinguishers. Although it is for transport airplanes and rotorcraft, it is used as guidance for small aircraft, as well. Since publication of AC 20-42, much has changed in the civil fleet in aircraft cabin size, configuration, materials, and operating environment, all of which bear on fire protection. There have been new developments in extinguisher agents and design, and new service experience has been accumulated. AC 20-42 is widely used, and experience indicates it should be updated and expanded to increase its usefulness and more effectively cover all aspects of evaluating and selecting hand-held fire extinguishers.
R, D & E Effort Request: Conduct tests, analysis, literature searches, and assoc ted research, as necessary, and establish an information and data base from which can be

Routing Symbol	INTERNAL CLEARANCE Initials	Rtg. Sym	Date	SIGNATURE OF DIRECTOR	DATE	DESIRED COMPLETION DATE

PART II	INSTRUCTIONS To be completed by responsible headquarters program office or service if request initiated by a region or center.

Routing Symbol	INTERNAL CLEARANCE Initials	Rtg Sym.	Date	☐ APPROVED ☐ DISAPPROVED	DATE	PERSON TO CONTACT
				SIGNATURE OF DIRECTOR		RTG. SYM. / EXT.

PART III	PROGRAM MANAGEMENT STAFF COORDINATION		RTG SYM. ATF-4	DATE

PART IV	INSTRUCTIONS: To be completed by ARD with title and number of subprogram or project

R, D & E ACTION (Include estimate of accomplishment time and resources required)

Routing Symbol	INTERNAL CLEARANCE Initials	Rtg. Sym.	Date	☐ APPROVED ☐ DISAPPROVED ☐ RETURNED	PERSON TO CONTACT
				SIGNATURE OF DIRECTOR, ARD	ROUTING SYMBOL
					EXTENSION
				DATE	

FAA Form 9550-1 (4-78) SUPERSEDES PREVIOUS EDITION

developed regulatory and advisory material on hand-held fire extinguishers for small and transport airplanes and rotorcraft. Take into consideration service history of the various aircraft categories; types of fires likely to occur; types, quantities and effectiveness of extinguishing agents; extinguisher design features and performance; toxicity of extinguishing agents in neat and pyrolized forms; and other factors which you find pertinent to the selection of hand fire extinguishers. Coordinate with FAA Washington and regional offices concerned with aircraft type certification, operations and maintenance, and obtain information on current regulations, policy, means of compliance which have been found satisfactory, and problems which have occurred. Take into consideration the practices which have been found satisfactory by other agencies and recognized authroities in fire protection.

Cited Schmidt

File
Environmental

BELL HELICOPTER COMPANY
Interoffice Memo

3 April 1974
8H:JE:cj-497

Memo to: M. Kawa

Copies to: R. Fox, E. Sharp, G. Simpson

Subject: HAND OPERATED HALON 1211 FIRE EXTINGUISHER CHEMICAL GAS DISCHARGE COCKPIT VISIBILITY INTERFERENCE TEST

General

The subject test was conducted to determine the extent of visibility interference which would occur in rapidly discharging the Halon 1211 fire extinguishant in a closed cockpit, as might happen if a container were punctured by a bullet or used to put out a fire forward of the instrument panel. The question came up as to whether the fire extinguisher should be installed in the cockpit of the AAH and what effects the chemical agent would have in a closed cockpit if it were either accidentially or purposefully released where it might possibly interfere with the pilot's internal and external vision.

Fire Extinguishant Description

Halon 1211 (Bromochlorodifluoromenthane) is a colorless, non-corrosive liquified gas which evaporates rapidly leaving no residue. It does not freeze or cause cold burns, and will not harm fabrics, medals or other materials it contacts.

The fire extinguisher specifications are attached. The cylinder contains two pounds of Halon 1211 with a discharge time of 10 seconds. (It can also be obtained in a four pound container with a 12 sec. discharge time). The operating temperature is -40°F thru +130°F. The toxicity rating of the Halon 1211 was not addressed in this test. The classification given by Underwriter's Laboratories is shown in the attached table.

Test Procedures and Documentation

For convenience, the cockpit of the Light Twin Helicopter Mockup was used. A movie camera was installed in between and aft of the crew seats at approximately eyeball height, with the lens pointed straight ahead through the forward windscreen. At this angle, the instrument panel and overhead console were included in the camera view.

The discharge of the extinguishant was aimed toward the area where maximum visibility is required, i.e., toward the forward windscreen and at the face of the instrument panel. The entire container was released in ten seconds

during which time the camera ran continuously. Releasing the extinguishant through the discharge nozzle gave a wide flat pattern.

Results

The extinguishant's gaseous plume can be observed as it leaves the discharge nozzle and evaporates quickly. The gas was barely noticeable by the time it reached the instrument panel and forward windscreen with the only visually noticeable obstruction occurring momentarily at the discharge nozzle, and as a result no accumulation was observed which would be detremental to the visual demands of the crew.

J. H. Emery

J. H. Emery
Human Factors Engineering

APPROVED:

Bill Bowen

B. C. Bowen
AAH Human Factors
Group Engineer

ATTACHMENT

Attachment to
IOM 8H:JE:cj-497
4-3-74

Technical Leaflet 40-SCF-02
Rev. June 1973.

SWORDSMAN 2 lbs. and 4 lbs.
HAND OPERATED HALON 1211 (BCF) FIRE EXTINGUISHERS
Models 2-10 and 4-12
U.L. Rated 2-B:C and 5-B:C

DESCRIPTION

The Graviner Swordsman BCF fire extinguishers have been specifically designed to take advantage of the characteristics of Bromochlorodifluoromethane — Halon 1211, and are manufactured in Australia, U.S.A. and the U.K.

This revolutionary fire fighting agent combines high efficiency and very low toxicity with the absence of corrosive or residual effects. Halon 1211 (BCF) is recommended against fires involving:—

Class A: Small carbonaceous fires
Class B: Inflammable liquid fires
Class C: Electrical fires

Halon 1211 (BCF) acts rapidly on the fires by producing a heavy blanketing mist that eliminates air from the fire source, but more important, interferes chemically with the combustion process. It has outstanding properties in preventing reflash after the fire has been extinguished and is, in fact, the nearest to a universal extinguishant yet developed.

The very high insulation property of Halon 1211 (BCF) has been amply proved and tested on electrical equipment carrying 30,000 volts without leakage of current. The Swordsman is therefore safe for use on electrical fires.

Halon 1211 (BCF) is a colorless, non-corrosive liquefied gas which rapidly evaporates leaving no residue whatever. It does not freeze or cause cold burns, and will not harm fabrics, metals or other materials it contacts.

The Graviner Swordsman Halon 1211 (BCF) Fire Extinguishers (Models 2-10 and 4-12) consist of two major parts, one being the molded operating head embodying a discharge nozzle, lever, safety catch and red discharge indicator disc; the other being a drawn cylindrical container to conform to Underwriters Laboratories (U.L.) requirements.

A pressure gauge fitted to both extinguisher and spare charge indicates that each is serviceable and contains the specified dry nitrogen supercharge when the needle registers in the "green sector."

OPERATION

The extinguisher is easily removed from its bracket with one hand. To operate, hold the Swordsman in either hand, slide the (red) safety catch down with thumb, direct the nozzle towards the base of the fire source and squeeze the lever with the palm of the hand. This will cause a piston valve in the operating head to fracture a frangible plug seal on the top of the container, thus releasing the extinguishant through the discharge nozzle which is designed to give a wide, flat pattern.

Releasing the lever closes a secondary seal and interrupts the flow of extinguishant, thus retaining part of the charge without waste, for dealing with re-ignition or flash-backs, should they occur.

On first pressing the lever, a red indicator disc is ejected from the rear of the operating head. This provides a visual indication of partial or complete discharge. A partly or fully discharged cylinder should be replaced immediately after use.

All Graviner Swordsman fire extinguishers can be factory recharged and resealed. Each replacement cylinder is fitted with a transport cap and a red indicator disc.

SPECIFICATIONS

Models 2-10 and 4-12 Swordsman.

Contents	2 lb. Halon 1211 (BCF)	4 lb. Halon 1211 (BCF)
Discharge Time	10 Seconds	12 Seconds
Model No.	2-10	4-12
Charge Pressure (Nitrogen)	100 psig @ 68°F.	70 psig @ 68°F.
Test Pressure (Cylinder)	300 psi	210 psi
Operating Temperature	−40°F thru +130°F	−40°F thru +130°F
UL Rating	2-B C	5-B.C
PHYSICAL DIMENSIONS		
Height	12.45"	15.15"
Diameter	2.73"	3.5"
Projection from wall	3.09"	3.95"
Extinguisher weight	4¼ lbs.	7¼ lbs.
Replacement cylinder weight	4 lbs.	7 lbs.
MATERIALS OF CONSTRUCTION		
Cylinder	Lightweight heavy duty steel plated	Lightweight heavy duty steel plated
COLORS	Red — Standard Yellow — Option	FINISH Plated, etch primed and stove-enamelled.

NOTE. Operating heads for both the 2-10 and 4-12 extinguishers are identical and interchangeable.

INC.
PLAINSIDE, N. J.

COMPARATIVE TOXICITY OF HALON 1211 (U.L. Classification)	RJN/gt	GI SK 304
		2 Nov. 1973

Attachment to:
8H:JE:cj-497
4-3-74

Table A-4

Underwriters' Laboratories Classification of Comparative Life Hazard of Various Chemicals

(Based upon Exposure of Test Animals)

Group	Definition	Examples
6 (least toxic)	Gases or vapors which in concentrations up to at least 20 percent by volume for durations of exposure of the order of 2 hours do not appear to produce injury.	Halon 1301 Halon 122 (R-12)
5a	Gases or vapors much less toxic than Group 4 but more toxic than Group 6.	Halon 1211 Carbon Dioxide
4	Gases or vapors which in concentrations of the order of 2 to 2½ percent for durations of exposure of the order of 2 hours are lethal or produce serious injury.	Methyl chloride Dibromodifluoromethane Ethyl bromide
3	Gases or vapors which in concentrations of the order of 2 to 2½ percent for durations of exposure of the order of 1 hour are lethal or produce serious injury.	Chlorobromomethane Carbon tetrachloride Chloroform
2	Gases or vapors which in concentrations of the order of ½ to 1 percent for durations of exposure of the order of ½ hour are lethal or produce serious injury.	Methyl bromide Ammonia
1	Gases or vapors which in concentrations of the order of ½ to 1 percent for durations of exposure of the order of 5 minutes are lethal or produce serious injury.	Sulfur dioxide

Extract from N.F.P.A. Standard 12B (12B-42)

13.0 FLIGHT CONTROLS

(No Agenda Item Submitted. For Future Reference Only)

14.0 FUEL

(No Agenda Item Submitted. For Future Reference Only)

15.0 HYDRAULIC

(No Agenda Item Submitted. For Future Reference Only)

16.0 ICE & RAIN PROTECTION

AGENDA ITEM 16.1
WEATHER AVOIDANCE SYSTEMS

PROBLEM:

FAR § 135 requirement for thunder storm detection system/weather avoidance system (Reference enclosed items from AGL-213).

STATUS:

ACTION:

DISCUSSION:

AWS-130 and AGL-213 provided a general overview and status of the subject problem. The enclosed documentation provides the current agency position relative to Part 135 operations. For other applications, no minimum performance standard is available. Air Force Flight Dynamics Lab Flight Test/Evaluation report is available; A NASA Langley Research Center report to be available in early 1980.

A draft Order (enclosed) for installation of equipment is to be available in the near future. No airworthiness guidance is anticipated at the present time.

The enclosed draft Order for "Airworthiness and Operational Approval of Airborne Systems to be used in Lieu of GPWS" is provided for your information.

CONCLUSION:

AWS-330 to issue a Order on Ryan Stormscope by 12/79. AWS-130 to issue a Order on Equipment in Lieu of GPWS by 12/79.

SUBJECT: Weather avoidance systems.

BACKGROUND: New FAR 135 requires weather avoidance systems and authorizes systems other than radar as weather avoidance systems. It is assumed that the Stormscope is the system other than radar that is intended.

DISCUSSION: Before New FAR 135 came out Stormscopes had been installed by field approvals on a no hazard basis, with no operations to be predicated on their use. To our knowledge there had not been any STC's issued for the installation of Stormscopes prior to new FAR 135 issuance. There are now one or two STC's but they are approved on a no hazard basis with no determination made relative to the equipment performing its intended function. New 135.173 requires "approved thunderstorm detection equipment" be installed on aircraft "of 10 seats or more". New 135.175 requires "approved airborne weather radar equipment" be installed on "large, transport category" aircraft.

It is anticipated that operators with Stormscope equipment installed will expect their equipment to be approved for FAR 135 operations in accordance with 135.173. For the district offices to issue such approvals they must determine that the equipment performs its intended function. They have no guidance information on which to make such a determination. They should be looking to engineering for such guidance and engineering should be consistent from region to region.

We have not received any information from Washington on the problem. Such guidance information is needed immediately as the effective date for implementation is December 1, 1979.

Weather radar has been in use for an extended length of time and a basic functional check of its operation can be accomplished by checking ground

:eturns. Although this is inadequate for determining that it will detect thunderstorms or other potentially hazardous weather conditions, it does establish its basic functional ability after installation. Data should be made available to co late basic functional check results with ability to detect hazardous wea r conditions.

We have essentially no knowledge of the stormscope, but it appears that determination that it performs its intended function involves testing with actual hazardous weather conditions and establishing the relationship of its indication to the severity of the hazardous weather.

AVAILABLE OPTIONS:

1. Issue advisory circular setting forth weather avoidance systems performance criteria.

2. Issue an order setting forth procedures for determining compliance with \R 135.173 and FAR 135.175.

3. Ignore the problem.

ANALYSIS OF OPTIONS:

1. This is considered the best option. Performance criteria is needed for weather avoidance systems for all types of operations, not just Part 135 operations.

2. If an advisoty circular cannot be issued then this option would help with the immediate problem. It may be too little too late relative to the December 1 implementation date.

3. We had better not let this become a standard approach.

RECOMMENDATIONS: Adopt Option 1.

§ 135.173 Airborne thunderstorm detection equipment requirements.

(a) No person may operate a multiengine small aircraft that has a passenger seating configuration, excluding any pilot seat, of 10 seats or more in passenger-carrying operations unless approved thunderstorm detection equipment is installed in the aircraft.

(b) No person may begin a flight under IFR or night VFR conditions when current weather reports indicate that thunderstorms or other potentially hazardous weather conditions that can be detected with airborne thunderstorm detection equipment, required by paragraph (a) of this section, may reasonably be expected along the route to be flown, unless the airborne thunderstorm detection equipment is in satisfactory operating condition.

(c) If the airborne thunderstorm detection equipment becomes inoperative en route, the aircraft must be operated under the instructions and procedures specified for that event in the manual required by § 135.21.

(d) This section does not apply to aircraft used solely within the State of Hawaii, within the State of Alaska, within that part of Canada west of longitude 130 degrees W, between latitude 70 degrees N, and latitude 53 degrees N, or during any training, test, or ferry flight.

(e) Without regard to any other provision of this Part, an alternate electrical power supply is not required for airborne thunderstorm detection equipment.

§ 135.175 Airborne weather radar equipment requirements.

(a) No person may operate a large, transport category aircraft in passenger-carrying operations unless approved airborne weather radar equipment is installed in the aircraft.

(b) No person may begin a flight under IFR or night VFR conditions when current weather reports indicate that thunderstorms, or other potentially hazardous weather conditions that can be detected with airborne weather radar equipment, may reasonably be expected along the route to be flown, unless the airborne weather radar equipment required by paragraph (a) of this section is in satisfactory operating condition.

(c) If the airborne weather radar equipment becomes inoperative en route, the aircraft must be operated under the instructions and procedures specified for that event in the manual required by § 135.21.

(d) This section does not apply to aircraft used solely within State of Hawaii, within the State of Alaska, within that part of Canada west of longitude 130 degrees W, between latitude 70 degrees N, and latitude 53 degrees N, or during any training, test, or ferry flight.

(e) Without regard to any other provision of this Part, an alternate electrical power supply is not required for airborne weather radar equipment.

DEPARTMENT OF ANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

DATE: DEC 26 1978

REPLY TO: AFS-130

SUBJECT: Policy and Standards Relative to Requirements in Revised Part 135, §§ 135.153, 135.173, and 135.411(a)(2); AGL-200 (AGL-213) ltr dtd 11/3/78

FROM: Chief, Engineering and Manufacturing Division, AFS-100

TO: AGL-200
Attn: AGL-210

The word "approved" in §§ 135.153 and 135.173 has the same emphasis as "approved" in the airworthiness regulations.

The Director requested the authority from the Administrator to make the technical finding with regard to the requirements in § 135.153. The Administrator granted this delegation.

The opportunity to utilize other than standard equipment under § 135.153 (ground proximity warning equipment) and § 135.173 (weather radar) was an administrative decision of the Director with regard to Radbar and Ryan Stormscope. Minimum performance standards have not been adopted, nor are they thought necessary since the Radbar specifications have been accepted under an exemption for ground proximity warning systems and installations have been approved for the Ryan Stormscope.

Section 135.411 will permit an STC to reduce seating configuration from 10 or above to a seat configuration of 9 or less since the type certification configuration is the basis for seating configuration consideration. Proposed Advisory Circular 135-3B, "Air Taxi Operators and Commercial Operators" will provide additional policy.

JAMES O. ROBINSON

210 211
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ENG & MFG BR.
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D.M.W.

NOV 3 1978 FILE: 8040

AGL-213: 8040

Policy and Standards Relative to Requirements in New Part 135.

Chief, Flight Standards Division, AGL-200

AFS-100

New 135.153 requires a ground proximity warning system that meets the TSO or one approved by the Director, Flight Standards Service. Why does this requirement specify the Director rather than the Administrator like all past regulations? Does "approved" in this case mean the same thing as "approved" in the airworthiness regulations? Appropriate policy is requested.

New 135.173 requires approved thunderstorm detection equipment. To our knowledge we do not have any standard for such equipment. Again, does "approved" have the same meaning as in the airworthiness regulations? We anticipate immediate applications for approval of this equipment to meet this new requirement and request that appropriate policy material be issued.

New 135.411(a)(2) requires a higher level of maintenance on aircraft with seating configurations, excluding any pilot seat, of ten seats or more. We have past experience that indicates to us that we will receive STC applications to change aircraft with TC approval for ten or more seats to nine seats in order that the applicant can escape the higher level of maintenance (and its economic penalties). We therefore request policy relative to disposition of such applications now, before we are faced with the application.

Original Signed by

JOHN B. BARRIAGE

AGL-213:DMWarner:gah:x379:10-30-78

AFS-2[illegible]

JUL 2 3 1979

Mr. Paul Ryan
President, Ryan Stormscope
4800 Evanswood Drive
Columbus, Ohio 43229

Dear Mr. Ryan:

We have reviewed your request that Federal Aviation Administration, Flight Standards Service approve the Ryan Stormscope as a system that meets the requirements of Section 135.173 of the Federal Aviation Regulations.

Tests have shown that this system has enough correlation with ground and airborne weather radar that the Ryan Stormscope may be used for thunderstorm and severe weather avoidance. Therefore, operators conducting operations in accordance with Part 135 may opt to use a Ryan Stormscope to meet the requirements of Section 135.173, if the equipment is properly installed and the operator's approved pilots' training program includes appropriate information on use of the system.

The Ryan Stormscope System was not tested for thunderstorm penetrations. Therefore, this approval does not include this authorization.

Sincerely,

Original signed by
JAMES M. VINES

ACTING DIRECTOR,
FLIGHT STANDARDS SERVICE

AFS-222:ACrook:pam:x68086:7/12/79
cc: AFS-222/220/200/1/240/All Regional Flight Standards Division Chiefs
rc: AFS-9 1423 sus: 7/20/79
file: 2100-6

ORDER DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8000.

DRAFT

SUBJ: INSTALLATION OF AIRBORNE THUNDERSTORM DETECTION EQUIPMENT

1. PURPOSE. To provide methods, techniques, and practices acceptable to the Administrator concerning the installation of approved airborne thunderstorm detection equipment.

2. DISTRIBUTION. This order is distributed to branch level in the Offices of Flight Operations and Airworthiness; regional Flight Standards offices to the branch level; to the Flight Standards National Field Office; to all Air Carrier, Flight Standards, Engineering and Manufacturing, and General Aviation District Offices, and to all International, Aeronautical Quality Assurance, and International Aviation Field Offices.

3. BACKGROUND. FAR Section 135.173(a) requires the installation of approved thunderstorm detection equipment in a multiengine small aircraft that has a passenger seating configuration, excluding any pilot seat, of 10 seats or more in passenger-carrying operations. At the present time, there has been no thunderstorm detection equipment with Technical Standard Order approval nor has there been approval of the equipment as a result of being installed in an aircraft which has undergone type certification. The Ryan Stormscope system has been approved by the Administrator for thunderstorm detection only. Supplemental Type Certificates (STC's) have been issued which concerned installations of the Ryan Stormscope WX-7A system. The limitations and conditions of the STC's specified, in part, that the data pertaining to the modifications are considered inadequate for duplication in other aircraft.

4. APPROVAL. Field approvals of thunderstorm detection equipment installations, if not installed under a type certificate or supplemental type certificate, must be handled as a major alteration. Installation instructions and test procedures provided by the thunderstorm detection equipment manufacturer are acceptable guidelines provided the installation does not affect the airworthiness of the aircraft.

Distribution: A-W(WS/FO)-3; A-X(FS)-3;
AFO-500(20 copies);
A-FFS-1,2,3,5,7,8(STD); A-FIA-O(MIN)

Initiated By: AWS-330

ORDER DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

DRAFT

SUBJ: Airworthiness and Operational Approval of Airborne Systems to be used in Lieu of a Ground Proximity Warning System(s) (GPWS)

1. PURPOSE. This Order provides information and guidance to FAA Regional and Field Personnel regarding the Airworthiness and Operational Approval of Airborne Equipment/System(s) in accordance with FAR 135.153(b)(c).

2. REFERENCES. Federal Aviation Regulations (FAR's) 135, 135.153(b)(c), 37, 37.201 and AC 25-6.

3. DISTRIBUTION. This order is distributed to the Office of Airworthiness and the Office of Flight Operations in headquarters to the branch level, to all Flight Standards Offices in the region, Aeronautical Center to the branch level and all Flight Standards Field Offices.

4. BACKGROUND.

a. FAR 135.153(b) allows the use of a system in lieu of a Ground Proximity Warning System (GPWS) for certain turbojet operations conducted under FAR 135. FAR 135.153(b) also requires that the use of any such system must be approved by the Director, of Flight Standards Service.

b. Since the Flight Standards Service has reorganized at the Washington level, that approval should now come from the Office of Airworthiness, and the Office of Flight Operations.

5. GENERAL GUIDELINES.

a. The equipment/system to be used in lieu of a GPWS should perform the same basic functions as the GPWS; that is, convey warnings of excessive closure rates with the terrain and excessive deviations below a glide slope.

6. AIRWORTHINESS CONSIDERATIONS. The airborne equipment/systems which may be under consideration, in lieu of a GPWS, should use the same basic performance standards provided in Radio Technical Commission for Aeronautics (RTCA) Document No. DO-161A, titled "Minimum Performance Standards, Airborne Ground Proximity Warning Systems," dated May 27, 1976, as modified by this order and permitted by FAR 135.153(b)(c).

Distribution: Initiated By:

DRAFT

a. Equipment/System Considerations - The words "Equipment/System" as used herein includes all of the components, subsystems, or units necessary to perform its intended function. For an example, the equipment/system could include cockpit controls, display, computing unit, aural warning unit, etc. The equipment/system need not include the associated sensors for which other performance standards are applicable e.g., radio altimeter.

(1) Location of Display and Controls. Display and controls should be visible to, and usable by each pilot while seated at his duty station if the equipment is to be operated by the pilots.

(2) Control(s) Considerations.

(a) Controls which are not normally adjusted in flight need not be readily accessible to the crew.

(b, Controls should be arranged to provide adequate protection against inadvertent turnoff.

(c) The operation of controls intended for use during flight, in all possible combinations and sequences, should not result in a condition whose presence or continuation would be detrimental to the continued performance of the equipme ystem.

(3) Failure Protection. Any probable failure of the equipment/system should not derogate the normal operation of equipment connected to it nor should normal operation result in failure or degraded performance of interfaced equipment. Likewise the failure of interfaced equipment should not render the equipment/system inoperative.

(4) Failure Monitoring and/or Self Test. Would be used to provide a positive indication of status or conditions.

(5) Unwanted/False Warnings. The equipment/system should be designed to minimize unwanted or false warnings.

(6) Environmental Conditions. The equipment/system should be capable of performing its intended function over the environmental ranges expected to be encountered in actual operation. The RTCA Document No. DO-160, titled "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments" (current issue) should be utilized.

(7) Aircraft Electrical Power Source. The equipment/system should be installed so that it receives electrical power from a bus that provides maximum reliability for operation without jeopardizing essential or emergency loads assigned to that bus.

DRAFT

b. Demonstration of Performance. An applicant for approval of the equipment/system installation should show that performance can be demonstrated by a combination of ground and flight evaluations:

(1) Ground Evaluation. After installation, an operational/ functional check should be performed to demonstrate compatibility between the equipment/system and the aircraft electrical/ electronic systems, all normal operating functions are exercised, and any emergency/failure conditions expected may be observed.

(2) Flight Evaluation. The equipment should be flight evaluated to determine that the design and installation criteria are met. All modes of operation should be functionally checked and verified. Airplane Flight Manual procedures should be evaluated, including abnormal and emergency procedures if applicable.

c. Airplane Flight Manual. The Airplane Flight Manual should contain the following information (if applicable):

(1) Normal procedures for operating the equipment.

(2) Equipment operating limitations.

(3) Emergency/Abnormal operating procedures.

d. Airworthiness Approval. Applications for approval will be coordinated with the Office of Airworthiness and must be approved by AWS-1

7. OPERATIONAL APPROVAL GUIDELINES. FAR 135.153(b) requires that a system used in lieu of a GPWS be capable of conveying warnings of excessive closure rates with terrain and any deviations below glide slope by visual and aural means. Those requirements are basic. It is anticipated that equipment/systems submitted for approval for use under FAR 135.153(b) may also combine several other functions within the submitted systems, e.g., aural callouts of altitude below 1000 feet, landing gear not down warnings, etc. Consideration of these other warnings and indications is important, but the basic requirements of FAR 135.153(b) should not be compromised. Operational evaluation of a system should consider that the system will reliably and consistently perform the minimum basic functions.

Factors to consider vary in accordance with the equipment/system under review, but should include the below concepts.

a. The equipment/system should provide the flight crew with audible and visual information which will alert the crew to take proper action to prevent inadvertent contact with the terrain caused by:

DRAFT

- Unintentional close proximity to ground
- Excessive closure rates to terrain
- Negative climb rate after takeoff
- Excessive downward deviation from an ILS Glide Slope

b. Distinctive aural and/or visual information should be provided to warn of each condition in paragraph a. The aural warning should consist of words or sounds to command the attention of the flight crew to the situation in time to avoid inadvertent terrain contact. The equipment/system should be designed to minimize distracting audible signals where no threat to inadvertent ground hazard exits. The visual warning provided should be distinctive under all normal lighting conditions and commensurate with other cockpit warnings. Audio/visual warning methods should be compatible with the user's flight procedures.

c. Means to deactivate the warning indications may be provided for flight crew use in planned abnormal or emergency conditions.

d. An alert should be given at least by the time the aircraft is 1.5 dots below glide slope. A system that gives an alert when an aircraft is less than 1.5 dots below a glide slope is acceptable. Where a decision height is used as a parameter the glide slope alert may be inhibited when below decision height.

e. If glide slope alerting is deactivated, it should be automatically reactivated for the next approach.

f. The glide slope deviation alert should consist of the aural annunciation "Glide Slope" (or other acceptable annunciation). An aural warning related to altitude should take precedence over this alert.

g. A review of a summary of any flight experience that could provide data on the operational reliability and accuracy should be conducted. Pilot comments should be reviewed, if available.

h. An inflight evaluation of the equipment/system should be conducted to observe performance of the equipment in the 4 modes mentioned in paragraph 7a. Such evaluation should include observation of the system at other than optimum conditions (i.e. rough terrain on final approach, performance during circling approaches, etc.).

i. The operational evaluation should include a review of proposed Operations Manual revisions encompassing equipment/system description and operation. Proposed revisions to a MEL should also be considered, if appropriate.

8. ACTION.

a. Field offices/regions receiving requests for approval to use

DRAFT

certain equipment/systems in lieu of GPWS in accordance with FAR 135.153(b) should evaluate the equipment/systems using the guidelines contained herein as a minimum. A report of the evaluation should be forwarded to AFO-1/AWS-1, along with any pertinent documents and the evaluating office and region's recommendations. Requests for approval received by AFO-1/AWS-1 directly from a manufacturer or operator will be forwarded to the appropriate region for evaluation.

b. If approval is granted, a letter so stating will be issued from the Office of Airworthiness and the Office of Flight Operations directly to the requestor/applicant, with copies to the appropriate regions and field offices.

AGENDA ITEM 16.2
APPROVAL OF RADAR RADOMES

PROBLEM:

Radar radomes approval/determination of performance (Reference enclosed item from AGL-213).

STATUS:

ACTION:

DISCUSSION:

AGL-213 conducted a detailed discussion relative to the subject radome problem. Radome or Plastic Nose Cap Irregulaties, such as moisture entrapment, paint, erosion, etc., may cause radar transmissivity reductions down to 50-60% (new or repaired may be 90%). Erosion cap has an 8% drop by itself, but may be worse if extreme erosion has occurred. Antenna size and color radar are critical systems issues, as well as rain and icing attenuation effects. AWS-130 provided information on rain and icing attenuation effects testing recommended by NTSB and being investigated by DOD, NASA and FAA. RTCA SC-133 discussing the future interest for radar and radome systems as a compatible system package.

AGL-213 to investigate the need for guidance material for acceptable criteria in determining radar/radome systems performance.

CONCLUSION:

AGL-213 to prepare a draft AC on radar radomes by 2/80.

SUBJECT: Approval of radar radomes and determination that they perform their intended function.

BACKGROUND: A common practice for many years in Great Lakes Region was to approve a radome from a structural standpoint only and not make any determination relative to the transmission efficiency of the radome to radar frequencies. Within the past two years Great Lakes Region has started requiring that the radome's transmission efficiency be established by tests and appropriately stated in the design data or a statement be included in the installation data to the effect that the radome has been approved structurally but its ability to perform its intended function as a radome has not been determined. Such determination must be accomplished at installation. Subsequent activities relative to this program has revealed that large numbers of radars are installed behind plastic nose cones, etc., that were not designed and tested as radomes, that plastic "erosion protection caps" are added to radomes in service reducing their transmission efficiency in the dead ahead area (with resulting indication of reduced weather severity), and collection of moisture in radomes over extended periods of service, significantly reducing its transmission efficiency.

DISCUSSION: Weather avoidance equipment, such as radar, is required by the operating rules. It is routinely installed as a minor alteration by personnel whose qualifications to make a determination that it performs its intended function is questionable.

The structural nature of the radome dictates that its installation is a major alteration, but that its transmission efficiency is normally considered minor in nature (The FAA consistently used the approach of the 1930's relative to electronic items; if it doesn't affect the aircraft weight and balance, aerodynamics, powerplant, or controls, it is minor.).

Any change that affects the information displayed to a pilot for him to use in making decisions relative to safe flight should be classified as a major alteration. The installation of radar is such a change, and the transmission efficiency of radomes directly affects the pilot's radar display.

This is only the tip of the iceberg relative to the overall problem of what is a major or minor alteration, or what is a major change. But relative to radar, a large percentage of radar installations do not perform their intended function because of the radome's inability to pass radar frequency energy.

Accurate determination of a radome's transmission efficiency at manufacture is relatively simple. After installation on an aircraft it becomes almost impossible. Any checks after a radome is in service would require removal and return to the manufacturer for tests. We all know that will never be required.

What is needed is a meaningful test on the aircraft. At present ground return indication suffices as a radar functional check. This does not determine how much the radome reduces the radar's performance.

A ground test procedure could be developed such that the strength of target returns are determined without the radome in place. Then (without changing any control setting or by returning to pre-recorded settings) replace the radome and determine the strength of the same target returns. The change in target strength would be due to the radome's absorption of radar energy. Greater than 20% energy absorption plus or minus 30 degrees either side of dead ahead should not be allowed. Various tilt angles should be tested but this is very difficult on the ground. What is important is that the dead ahead area of the radome be checked.

Periodic tests of radomes in service should be required to assure continued service. Such tests are only meaningful if performed by qualified people. Attached is a transmission efficiency plot of a radome after it had been in service showing the effects of moisture absorption by the radome.

AVAILABLE OPTIONS:

1. Issue a advisory circular setting forth acceptable criteria for determining that a radome performs its intended function and require all radar installations have approved radomes.
2. Require a biannual check of radome's ability to perform its intended function.
3. Do nothing.

ANALYSIS OF OPTIONS:

1. This would be a big step in improving the performance of weather avoidance radar. Many very good radar systems are not providing the pilot with reliable information because of radome deficiencies. If we are going to allow operations to be predicated on the use of radar then we had better require the radar installation, including the radome, perform its intended function.

2. A perfect installation will deteriorate with time and service. Radomes are subject to erosion damage and even very slight damage results in moisture absorption after a period of time. Radomes should have periodic functional checks as well as visual checks. A visual check will not detect moisture absorption and neither will a flight check with weather targets.

3. Doing nothing will assure that many pilots will see a hole in the severe weather dead ahead regardless of the direction they are flying. Any resulting accident will never show the radome to have contributed.

RECOMMENDATIONS:

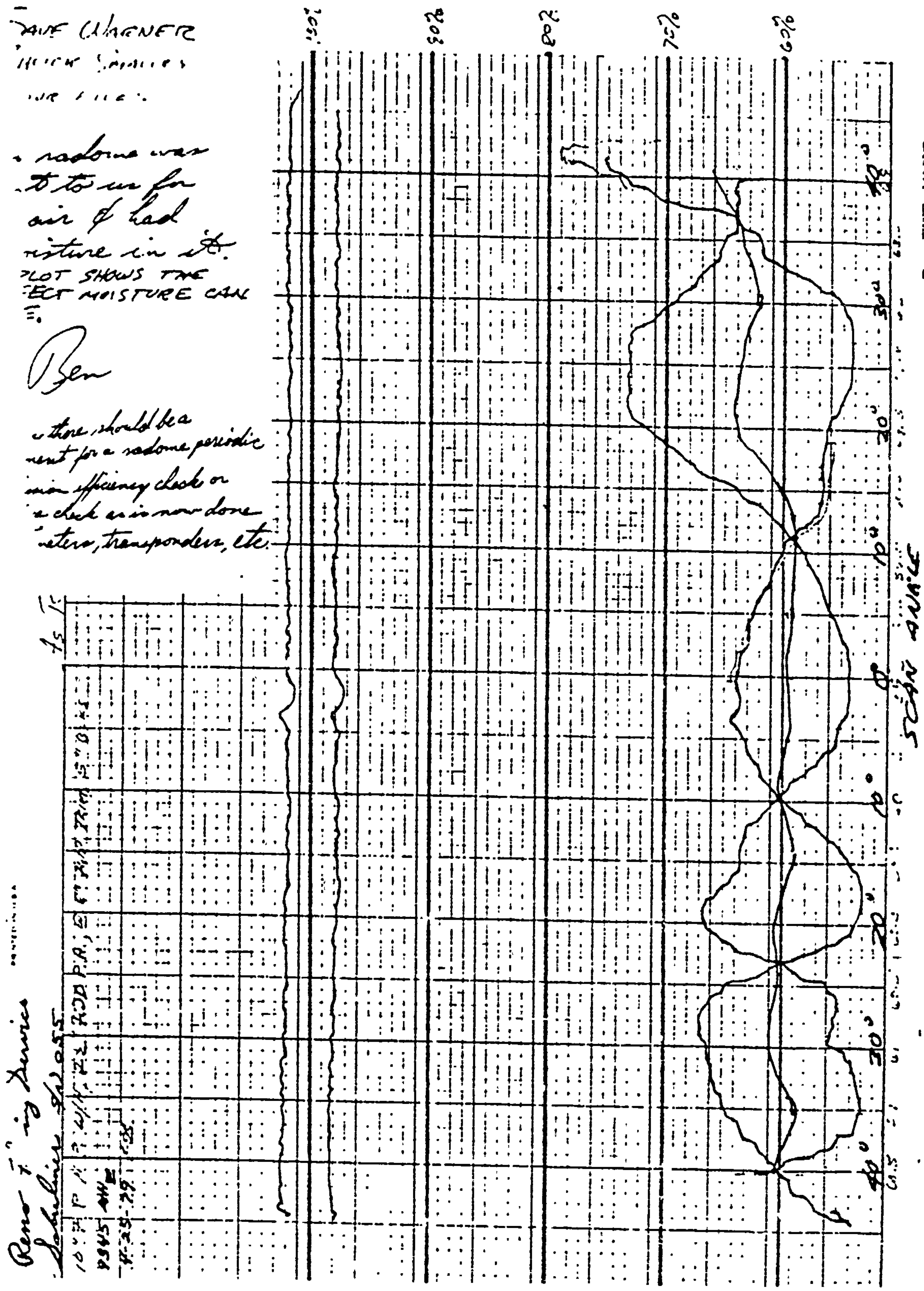
Adopt options 1 and 2.

DAVE WAGNER
...ICK SAMUELS
...R FILES.

...radome was ...t to us for ...air & had ...isture in it. ...PLOT SHOWS THE ...ECT MOISTURE CAN ...E.

Ben

...there should be a ...nent for a radome periodic ...ion efficiency check or ...a check as is now done ...eters, transponders, etc.



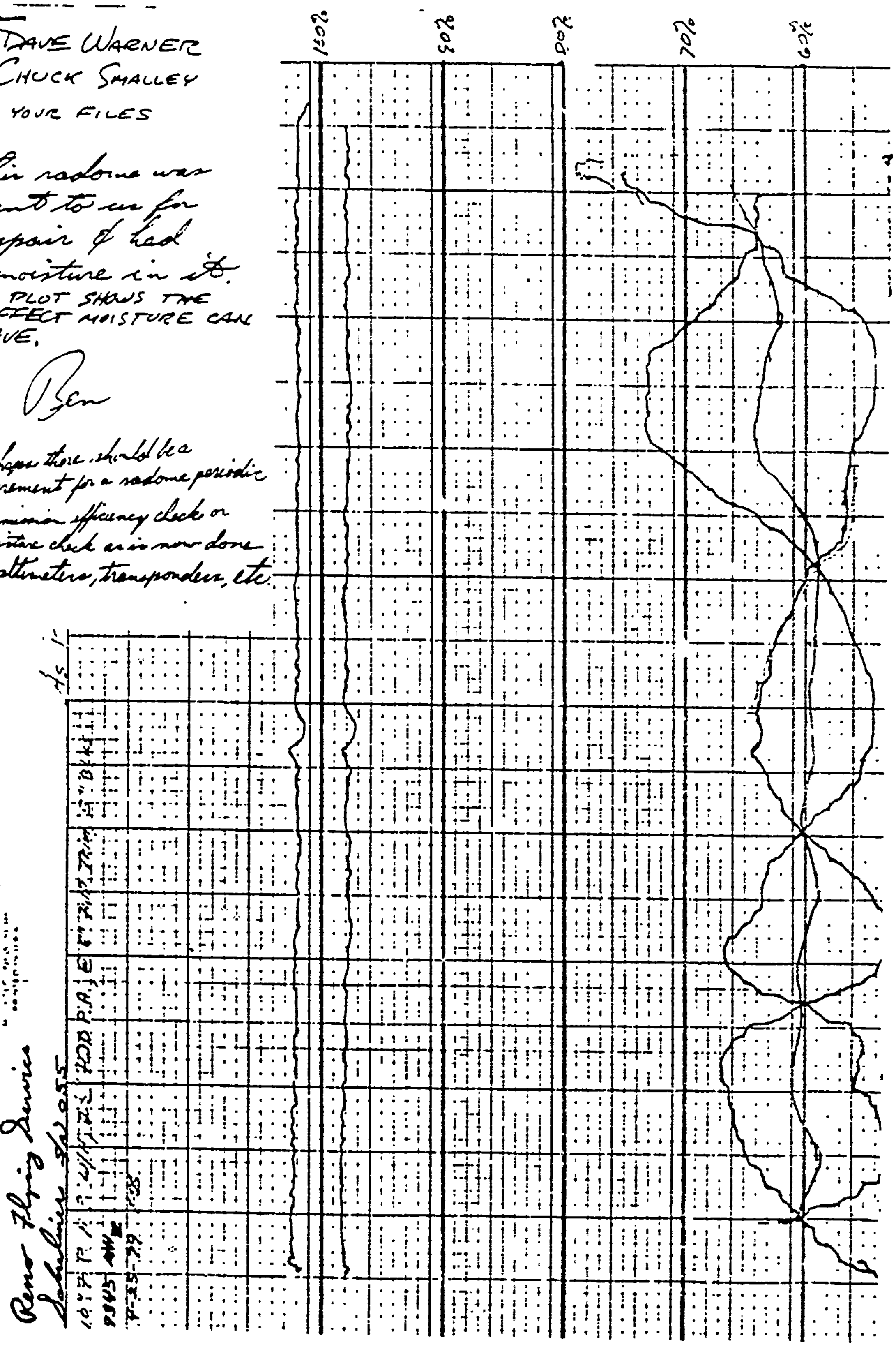
TO: DAVE WARNER
& CHUCK SMALLEY
- FOR YOUR FILES

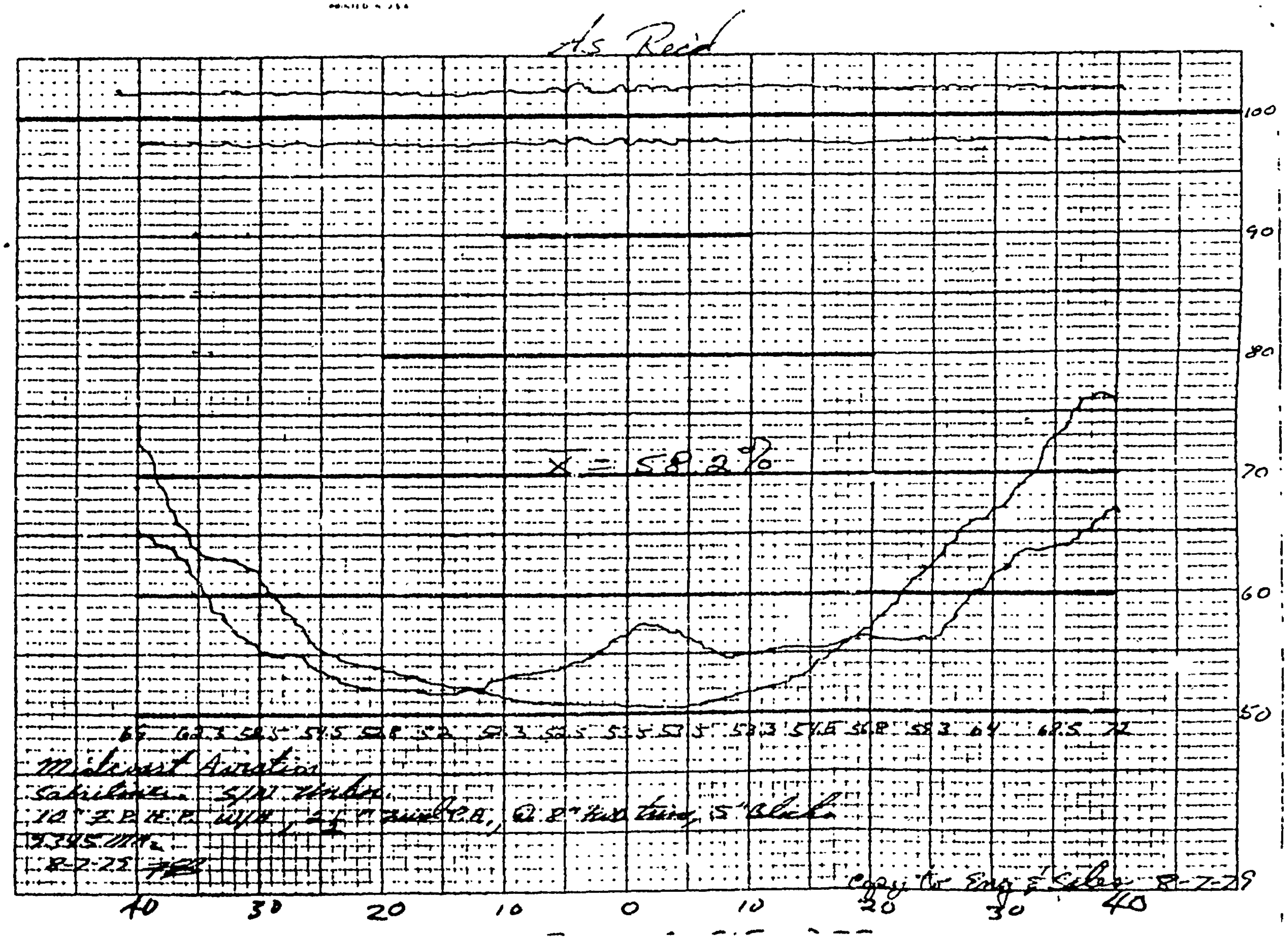
- This radome was sent to us for repair & had moisture in it.

- THE PLOT SHOWS THE EFFECT MOISTURE CAN HAVE.

Ben

* - Perhaps there should be a requirement for a radome periodic transmission efficiency check or moisture check as is now done for altimeters, transponders, etc.




As Rec'd
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40 30 20 10 0 10 20 30 40
Copy to Eng & Sales 8-7-79

NORTON COMPANY
REPAIR STATION 1527
QUALITY CONTROL RECEIVING INSPECTION REPORT

CUSTOMER MIDCOAST AVIATION THEIR ORDER NO. 21304

ITEM RADOME MODEL SABRELINER S/N UNKNOWN

MFGR. UNKNOWN MFGR. P/N UNKNOWN CUST. P/N

R/R NO. N12660 DATE REC'D 8-03-79 DATE INSP'D 8-06-79

INSPECTOR'S NO. 23 ACCEPTED X REJECTED

INSPECTION REPORT: NET WEIGHT: 6 LBS. 8 OZ.

OUTSIDE:
1. Moisture - unacceptable in nose area and on bottom side (marked in black).
2. Delamination - 6 previous attach holes that have been filled in by another company are delaminated (marked in red).
3. Holes - 3 holes drilled in radome - 2 in nose and 1 on bottom side (marked in red).
4. Diverter strip unbonded in nose area and 2" from trimline (marked in red).
5. Condition of paint - has chips, blisters and sanded off on nose area.
6. The erosion coating was removed by customer - looks like they had painted over the previous area. ½" of erosion coating still on radome.

INSIDE:
1. Moisture - unacceptable bottom side and nose area (marked in black).
2. Delaminations - 4" x 6" area on bottom side (marked in red).
3. 2 holes below the large phenolic block (marked in red).
4. Has 6 phenolic blocks attached to radome. The large block has 4 small holes drilled in it.
5. 15 previous attach holes have been reworked by another company (need to be reworked - holes half full) (marked in red).
6. Has unusual whitenss in nose area.

GENERAL: 1. To be overhauled as necessary.

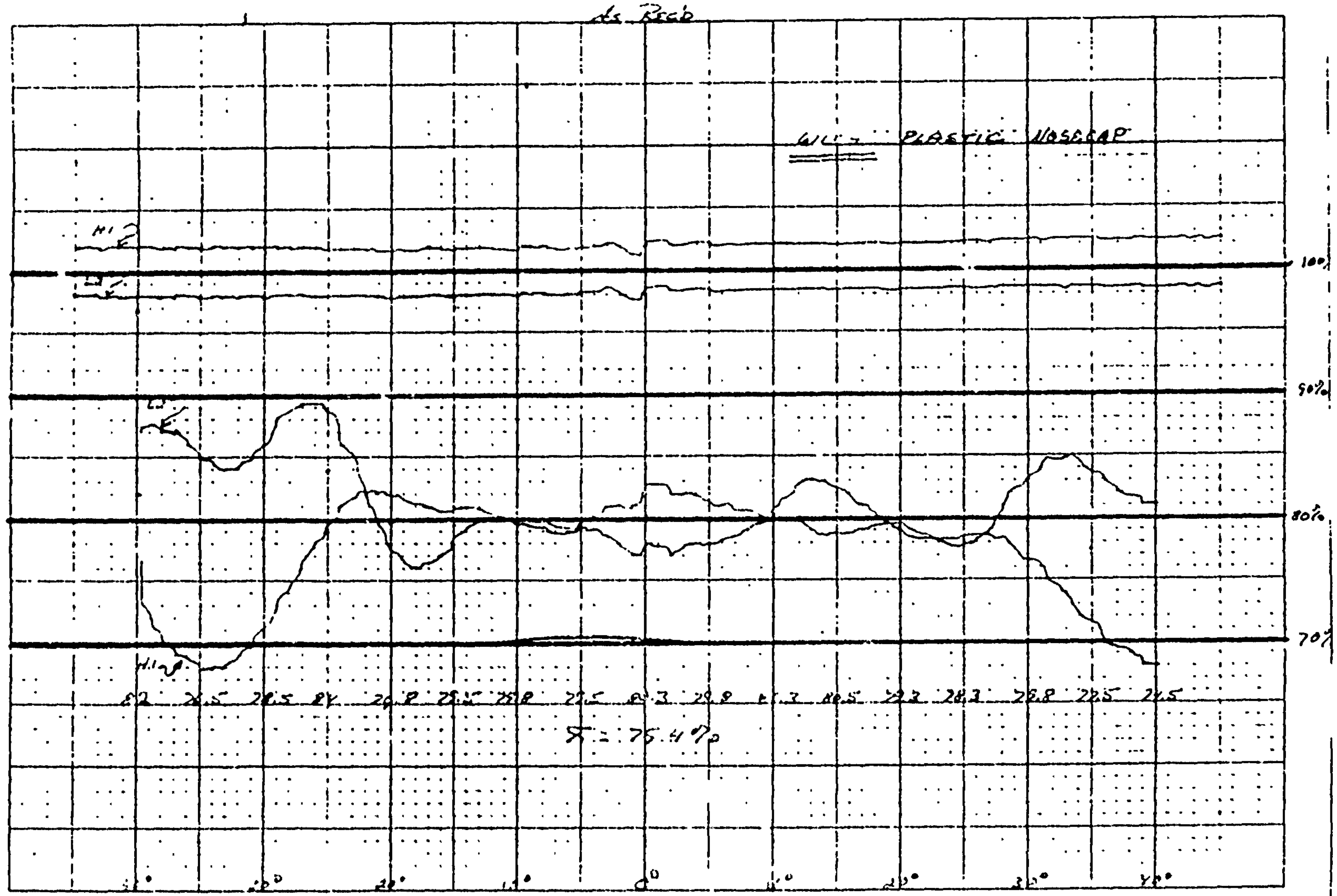
TRANSMISSION TEST AFTER REPAIR

DISTRIBUTION: W. Boccuti
E. Davis
B. Mackenzie (2)
Sales
Inspection

FINAL INSPECTION:

CAIR-9A
Rev 11-72

DATE OF RETURN SHIPMENT:


As Rec'd
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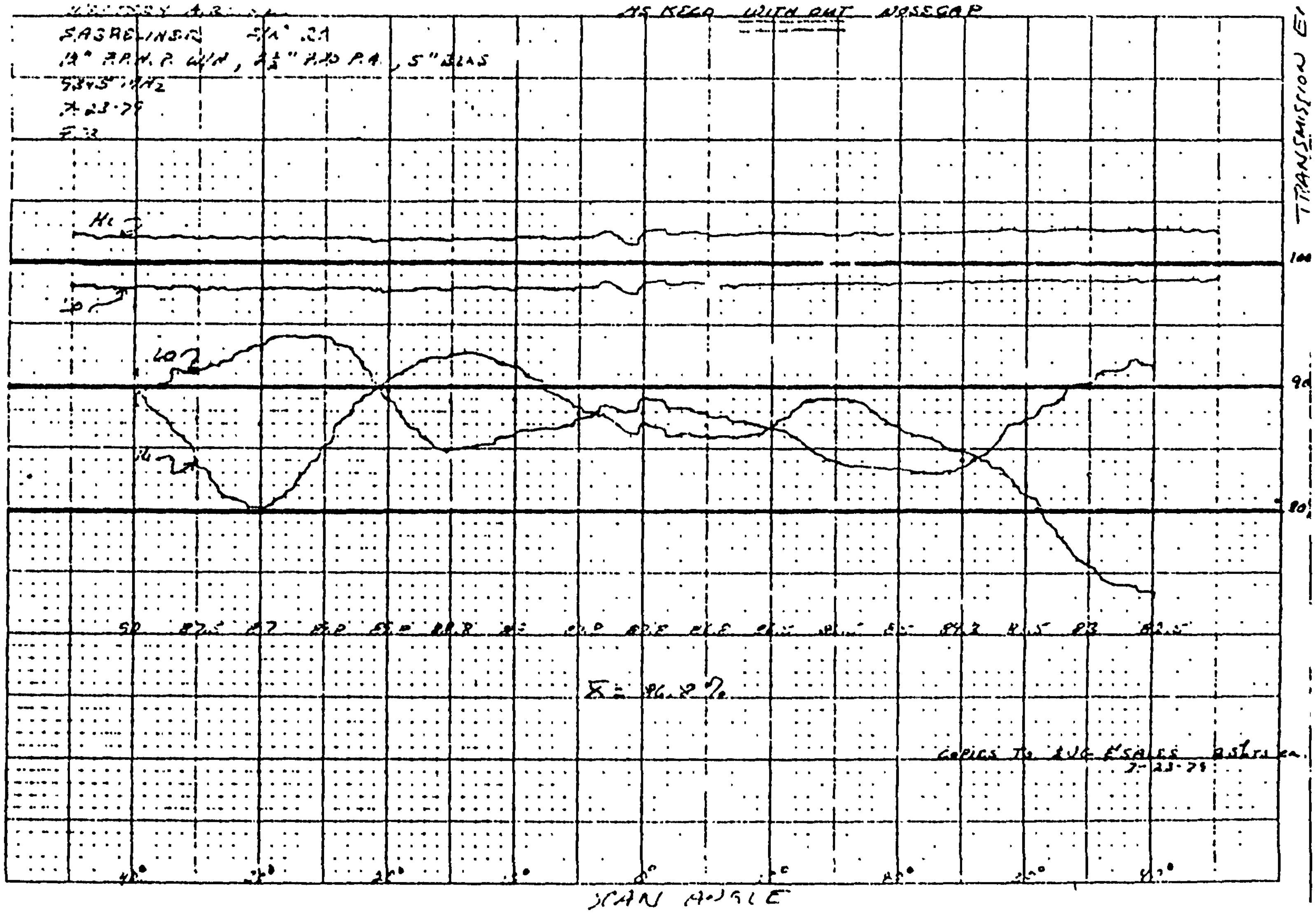
82 76.5 78.5 84 76.8 75.5 75.8 75.5 80.3 79.8 81.3 80.5 79.2 78.3 78.8 72.5 71.5
$\bar{X}$ = 75.4%



WITH OUT NOSECAP
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100
90
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SCAN ANGLE

17.0 INSTRUMENTS

AGENDA ITEM 17.1
MULTIPLE INSTRUMENTS IN ONE UNIT

PROBLEM:

Protection of multiple instruments in one unit/cluster (Reference enclosed item from ASW-210).

STATUS:

ACTION.

DISCUSSION:

The ASW-210 agenda item discussed in detail. Admit that previously multiple functions in a single box e.g., INS (navigation, heading, attitude) however, redundancy is required (3 INS systems).

New generation equipment will and are attempting to incorporate combined displays e.g., B-767 which uses a single symbology generator for attitude and heading display. A standby display generator would be required. AWE-130 stated that 25.1333 was developed to consider critical instruments in cooperation with 25.1309.

CONCLUSION:

AFO-512 to draft guidance material for multiple instrument package by 1/80, with reference to 23.1309 & 25.1309.

Review AC 20-41A, to determine compatibility to multiple instrument installation concept.

ASW-210

Problem: Multiple instruments in one unit.

Background: An applicant has attempted to install an instrument unit (TSO approved) in a helicopter wherein several required instruments are protected by one circuit breaker. Neither the applicant nor the instrument manufacturer saw any problem with this concept.

Discussion: This particular instrument manufacturer designed an instrument "cluster" wherein in one instance the engine oil pressure gages for both engines and the hydraulic pressure gages for both systems were all on one circuit protector. In another instance, both engine oil temperature gages and both ammeters were on one circuit protector. These are required instruments and we found they did not comply with FAR 29.1357e.

This problem does not fit the format requested of available options, etc. It is presented here to suggest discussion and to alert other regions of the possible controversy especially since these units were TSO'd. It seems unreasonable to TSO devices that cannot be used in today's aircraft.

AGENDA ITEM 17.2
ALL ELECTRIC ENCODING ALTIMETERS

PROBLEM:

Warning flag configuration and operation - all electric encoding altimeters (Reference enclosed item from AEU-100).

STATUS.

ACTION.

DISCUSSION.

Present flag usage is for power malfunctions only. All pneumatic, mechanical, and electronic instruments require updating to provide warning flag operation which correlates to valid data display.

CONCLUSION.

AFO-512 to prepare an NPRM to revise 23.1331 equivalent to 25.1331 by 2/80. Review Handbook 8110.4 to determine if a revision is required.

AWS-130 will attempt to update TSO-C10b (and other similar) by 3/80.

AEU-100

1979 Systems Workshop

AEU-100

2. SUBJECT: All electric encoding altimeters - Warning Flag configuration and operation.

BACKGROUND:

On one model ARC electric altimeter, the altimeter function stops at 18V (24V system) while the encoder flag does not appear until input voltage has dropped to 4 Volts. The altimeter is TSO'd to TSO's C10b and C88; However, only C88 requires a loss of power, warning flag. These altimeters are intended primarily for use in general aviation, light aircraft.

DISCUSSION:

Electrical instrument operation at low bus voltage raises several questions relative to installation criteria, validity of electrical versus mechanical driven displays and adequacy of TSO requirements.

Available Options:

1. Treat electrical altimeters the same as pneumatic/mechanical altimeters in that it is not possible to provide a flag for every condition resulting in invalid data display.

2. Require as a minimum on electrical instruments that there be a low voltage warning flag and that its operation is correlated to the point at which displayed data is no longer valid.

Analysis of Options:

It is difficult to predict the degree of error in electrical instruments for various types of failures or for low input voltage. Errors due to failures in mechanical instruments can be predicted in some cases plus there are no errors to consider due to electrical systems variations. Therefore, there is limited basis to consider Option 1.

RECOMMENDED:

1. Revise instrument TSO's for electrically driven displays or units that rely on electrical power, that warning flag operation correlate to valid data display and;

2. Issue installation criteria or a revision to Handbook 8110.4 with guidance for evaluating and approving flight instruments which depend on electrical power for valid data display.

AGENDA ITEM 17.3
PITOT-STATIC SYSTEM ISOLATION

PROBLEM:

Requested approval of an autopilot connected to the copilot's pitot-static system without an isolation valve (Reference enclosed item from ACE-210).

STATUS:

ACTION:

DISCUSSION:

A general discussion of the subject item was conducted by ACE-210, EMDO-43, and AWE-130. The discussion pointed to the fact of confusion, relative to interpretation of the rule and policy letter. Based on this confusion, it was recommended that a current investigation be conducted, review Part 23, 25, 27, 29 (.1333) and 4b.612, and develop a recommended course action.

CONCLUSION:

AFO-512 to review the results of the investigation and prepare a briefing memo by 1/80.

In addition to the discussion on the need for system isolation, it was also pointed out that some means should be provided to inform the copilot when it is necessary to isolate the pitot-static system from the other connected equipment. If it is practical, this means should be a warning light that indicates a failure of the connected equipment and instructions to close the isolation valve when a warning occurs. If it is not practical to provide such a warning, there should at least be information in the AFM that will advise the copilot to close the isolation valve in the event of a failure indication such as a difference in the readings provided by pilots and the copilot's system.

cc: EMDO-43C
AFS-130

ACE-210

Priority 3

WICHITA EMDO-43 AGENDA ITEM

SUBJECT: Pitot-static System Isolation - FAR 25.1333 and CAR 4b.612

BACKGROUND: FS-130 letter to ACE-213 dated March 16, 1971, advised that a shutoff means in the copilot pitot-static/autopilot connection is not required if the aircraft is operated in accord with FAR 91 and/or FAR 135. See attached copy of letter.

DISCUSSION: An STC applicant requested approval of an autopilot connected to the copilot's pitot-static system without an isolation valve. His request was made in view of his knowledge of the background letter.

It is believed the isolation means is necessary to comply with FAR 25.1333 regardless of operating rules.

In addition, when an isolation valve is installed what cues should be provided (if any) to alert the crew-member to isolate the system? Discussion requested.

OPTIONS: N/A

RECOMMENDATION: AFS-100 issue clarifying statements or letter retracting guidance in March 16, 1971 letter.

16 March

DATE: 16 March 1971
16 March 1971

IN REPLY REFER TO: FS-130

SUBJECT: Cessna 500 copilot pitot-static/autopilot connection

TO: CE-1
Attention: CE-213

On 15 March 1971, Messers. Gordon, CE-213, Archer, CE-213 and Schroeder, FS-130, discussed the lack of a shutoff valve to the autopilot on the copilots pitot-static system. The pertinent rule FAR 25.1333 is specific in that the rule is predicated on duplicate flight instruments being required by the operating rule. If Cessna wishes to limit their operation to FAR 91 and FAR 135 operation wherein duplicate flight instruments are not required, a shutoff valve to the autopilot need not be installed.

H. E. Waterman
H. E. WATERMAN
Chief, FS-130

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FAA-CENTRAL REG.
Eng. & Mfg.
Branch

RECORD OF ☐ VISIT ☐ CONFERENCE OR ☒ TELEPHONE CALL

TIME

DATE 6/8/78

NAME(S) OF PERSON(S) CONTACTED OR IN CONFERENCE AND LOCATION

Ray Borowski and Tom Ryan, AWE-130 called Earsa Tankesley

ROUTING

SYMBOL | INITIALS

SUBJECT

Isolation of the copilot pitot-static systems

DIGEST

The Wichita, Kansas EMDO is presently evaluating an autopilot installation STC on a CAR 4b airplane that proposed adding the autopilot to the copilot's pitot-static system without a means of disconnecting the autopilot in the case of a failure. In their evaluation of this proposal, they have also reviewed an AFS-130 letter, copy attached, dated March 16, 1971, which advised this region that this same installation was satisfactory on the Cessna Citation (FAR 25.1333 of Amend. 17) if Cessna wished to limit their operation to FAR 91 and FAR 135. Because of the difference in the wordage of 4b.612 and 25.1333 there was a question as to whether the guidance provided in this letter should be applied to 4b. airplane and, therefore, be used to find the proposed installation satisfactory. Accordingly, the EMDO requested that I discuss this subject with AFS-130 before they proceeded with this project.

When I contacted AFS-130, they requested that we provide them a copy of the above discussed 3/16/71, letter before they answered our question on the isolation of the copilot's system on a 4b airplane.

The call on this date was to advise that they had reviewed the copy of the letter we had provided and had discussed its contents with at least one of the persons involved at the time it was prepared. The results of their efforts showed that this letter is incorrect and should not have advised that this type of installation was satisfactory for FAR 91 and 135 operation of the Citation. The requirements of 4b and 25 do not depend upon the operating rules to support the need for two pitot-static systems, therefore, the need for isolation of the copilot's system also does not depend upon the operating rules. The various parts of both 4b and 25, instrument location, isolation of pilot's system, reliability, etc. require two independent systems and means of isolating each. They advised that we should not allow any items to be connected to the copilot's pitot-static system of a 4b or 25 airplane, unless there is a means to isolate that item from the system.

I reminded them of the Citation approvals that do not meet this requirement and that we had heard that there are other approvals where this isolation was not provided. Due to the possible difference in the interpretations of these rules, I suggested that their application be discussed at this years systems workshop. Ray agreed and made some notes to add this subject to the agenda.

DATE	TITLE	SIGNATURE
6/12/78	Aerospace Engineer	Earsa Lee Tankesley EARSA L. TANKESLEY

18.0 LANDING GEAR

AGENDA ITEM 18.1
FAR § 23.729(c) LANDING GEAR
EMERGENCY EXTENSION

PROBLEM:

Auxiliary means of extending the landing gear for emergencies (Reference enclosed item from ACE-210).

STATUS:

ACTION:

DISCUSSION:

It was a general concensus that the rule required two sources of power to extend the landing gear. Part 23 is not clear. Much policy information on an individual aircraft basis has been distributed (per enclosed documentation). In order to resolve the ACE agenda item, an NPRM AD was recommended. It was also suggested, that an investigation be conducted to change Part 23 to reflect similar requirements as in Part 25.

CONCLUSION:

ACE-210 to prepare a draft NPRM AD in early 1980.

Priority 1 ACE-210

WICHITA EMDO-43 AGENDA ITEM

SUBJECT: FAR 23.729(c) Landing Gear Emergency Extension

BACKGROUND: "Auxiliary means of extending the landing gear" has been interpreted to apply only to "power."

DISCUSSION: CAR 3.357 and FAR 23.729 states: "When other than manual power for the operation of the landing gear is employed, an auxiliary means of extending the landing gear shall be provided."

The attached memorandums and letter indicate the FAA position is that only a second source of power is required to comply with the regulation. There is much Regional disagreement with this position. Most believe the intent of the regulation is to provide an "emergency system" (means) for extending the gear. It is conceivable that a primary system can be shown to be so reliable that a second source of power would suffice as the "emergency means." However, a particular model aircraft manufactured in the Central Region has demonstrated it has a very unreliable primary system. The past five years has shown an average of one gear-up landing per month. The failure modes have been such that the second source of power was locked out of the system.

In applying this rule the system failure modes should be examined for "reasonably probable failure" points. If such exists then the "emergency means" should extend on into the system.

It is reasonable to assume that actuator failures should not be considered a failure mode.

OPTIONS: N/A

RECOMMENDATION: If concurrence is reached that "emergency means" applies to more than just a second source of power, AFS-100 should issue clarifying information.

C
O
P
Y

CIVIL AERONAUTICS BOARD

January 20, 1954

MEMORANDUM

TO: Director, Bureau of Safety Regulation, D-80

FROM: Chief, Airworthiness Division, D-33

SUBJECT: Interpretation of Section 3.337 - Emergency Operation - Landing Gear Retracting Mechanism

We have received a telephone request from Piper Aircraft through Mr. Peterson of the AIA regarding the intent of the subject regulation. The question is whether or not the hydraulic system with an engine driven pump would meet this requirement if an additional hand pump were introduced into the same hydraulic system, the hand pump being considered as the "auxiliary means".

After studying this problem, I have advised Mr. Peterson by telephone that the design proposed by Piper appears to meet the intent of the regulation. I explained that the wording of the regulation is such that the important factor is the "power" which is used for the operation of the landing gear, and not the complete hydraulic system, retracting strut, fittings, etc. In this particular instance the "power" is the pump. It appears, therefore, that having one engine driven pump and one manually operated pump provides two separate means of extending the gear.

It should be noted that there are a number of designs now in use, including the DC-3 and the Navion, which employ the same philosophy as is contemplated by Piper. In the case of the two mentioned airplanes a hydraulic system is employed, but the same principle is involved in the case of electrical systems.

I have checked with Messrs. Weeks, Springer and Spiess of the CAA, and with Mr. Copeland of D-41. They concur with my interpretation.

/s/
W. E. Koneczny

cc: Mr. Weeks, W-235
Mr. Copeland, D-41

UNITED STATES GOVERNMENT   FEDERAL AVIATION AGENCY

Memorandum

DATE: JAN 26 1968

SUBJECT: Burns - EA-42 Landing Gear Emergency Operation; SO-200 memo to FS-100 dated 1/5/68

In Reply Refer To: FS-120

FROM : Chief, Engineering and Manufacturing Division

TO : Director, Southern Region
Attention: Chief, Flight Standards Division, SO-200

The basic issue involved in your evaluation of the subject system is the intent of the term "auxiliary means" as used in FAR 23.729(c). The question as to whether or not this provision is adequate, and whether it should be amended to require anything other than what is presently required is a separate problem. As indicated in our memorandum of December 4, 1967, the term "auxiliary means" in FAR 23.729(c) refers only to the power source and does not require consideration of any "reasonable probable failure" in the hydraulic system as is presently required under FAR 25.729(c). Since the intent of the term "auxiliary means" has been previously provided, we see no need to establish a review case for the purpose of evaluating the subject system.

We agree that the term "auxiliary means" should be clarified and have already initiated a study project for this purpose. In regard to the need to amend the current provisions of FAR 23.729(c) we would appreciate receiving additional information to support the failure rate associated with FAR 23 type aircraft hydraulic landing gear systems as implied in your memorandum. Our review of the General Aviation Accident Summary for 1/1/67 thru 10/31/67, indicated that only one accident was attributed to hydraulic power failure. This case was not considered pertinent since the pilot apparently misused the emergency gear system.

H. H. Slaughter

H. H. Slaughter, FS-100

RECEIVED
JAN 30 1968
FLIGHT STANDARDS DIVISION
SOUTHERN REGION
F.A.A.

2.10
213

UNITED STATES GOVERNMENT FEDERAL AVIATION AGENCY

Memorandum

DATE: DEC 4 1967

SUBJECT: Burns BA-42 landing gear emergency extension; SO-210 memo of 9/15/67

In Reply Refer To: FS-130

FROM : Chief, Engineering & Manufacturing Division

TO : Director, Southern Region
Attention: Chief, Engineering & Manufacturing Branch, SO-210

We have reevaluated the landing gear system proposed for the Burns BA-42, and conclude that, in principle, it complies with the intent of FAR 23.729(c). This particular rule has been subjected to varying interpretations; however, extensive service history shows no unusual problems even in those cases where the less conservative interpretation has been applied. Numerous aircraft, presently in operation, incorporate systems similar to that proposed by Burns, and the service experience known to us has not been adverse. This is considered to be a positive indication of the acceptability of the design in general.

The rule in question requires "auxiliary means," and the available background material does not specify whether this term intends a completely dual system, able to withstand any possible single failure, or whether a second source of power is intended. CAR 3.357 aimed the requirement at the case "When other than manual power ..... is employed .....," indicating that a second source of power is intended. This is in accord with a memorandum dated January 20, 1954 from B-88 to B-80 concerning this general subject, copy attached.

An additional consideration is the FAR 25.729(c) requirement for "emergency means," which may be effective only in the event of any reasonably probable failure in the retraction system or a single power source failure. This transport category requirement is not all encompassing, as would be the FAR 23 requirement if it were applied to require consideration of all possible single failures.

In view of the lack of clarity evident in the rules, we plan to initiate a project for the consideration of a revision of the pertinent rules, but, in the immediate case of the Burns BA-42, we suggest your serious consideration of acceptance of the system proposed, subject, of course, to your detailed evaluation, and assuming that a suitable emergency power supply will be provided.

H. H. Slaughter, FS-100

Attachment

DEC 5 '67

JAN 5 [illegible]

FILE DESIGNATION

Burns - PA-42 Landing Gear Emergency Operation; FS-130 memo of 12/4/67 and SO-210 memo of 9/15/67

In reply refer to: SO-213

Chief, Flight Standards Division

Chief, Engineering and Manufacturing Division, FS-100

We have re-evaluated the Burns' proposal for emergency landing gear extension as suggested in your subject memorandum. We agree that only reasonable probable failures should be considered. Since reasonably probable failures can occur and will result in complete loss of the ability to extend the landing gear, we are requesting a review case of the Burns' proposal for emergency landing gear extension. The system proposed by Burns provides an auxiliary means of supplying pressure. For any probable failure in which fluid would be lost, an alternate means could not be provided by the auxiliary pressure source and the gear could not be lowered.

A detailed re-evaluation in view of FAR 23.729(c), which requires that a land plane without manually operated landing gear must have an auxiliary means of extending the gear, reaffirms our initial concern that an auxiliary means has not been provided. We are thus forced to conclude, in view of the probable failure criteria and service history of hydraulic fittings, piping and components, that this design cannot comply with the intent of FAR 23.729(c) as presently configured.

We note a day-to-day exposure of reports of failure within the hydraulic systems of the very kind that we are concerned with here and consequently are hesitant to concur with the comment in your December 4 memorandum to the effect that service experience has not been adverse. Should a complete history of such adverse service experience be necessary, the Oklahoma NAC files supplemented by the incidents known to each region will, we believe, confirm our reluctance to accept the proposed system.

To certificate an airplane without a backup for lowering of the landing gear following a reasonable probable fault would not be in keeping with the airworthiness requirements, notwithstanding the fact that Cessna and Piper have produced airplanes said to be so configured. Because of the hazardous results following a probable failure, we recommend that the regulation be amplified and/or clarified to require an independent means of lowering the landing gear and further, that those affected airplanes, previously approved under DOA, be corrected if necessary.

COORDINATION	
RTG. SYMBOL	SO-213
INITIALS/SIG.	[illegible]
DATE	1-5-67
RTG. SYMBOL	ATL-EKS
INITIALS/SIG.	[illegible]
DATE	1-5
RTG. SYMBOL	SO-216
INITIALS/SIG.	[illegible]
DATE	1-5-67
RTG. SYMBOL	SO-201
INITIALS/SIG.	[illegible]
DATE	1/5
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Form 1360 [illegible] PREVIOUS EDITION

OFFICIAL FILE COPY

RETURN FOR FILING TO SO-213

Our memorandum of September 15, 1967, listed the correspondence, date, and other pertinent information believed necessary for this review case. If additional information is required from Bunia Aircraft Company or [illegible] Aircraft Systems, we will furnish it upon your request.

Gordon W. Becker, [illegible]

cc:
ATL-EMDO

CWKaiser:ss:30-213:x7428:1/5/68

19.0 LIGHTS

AGENDA ITEM 19.1
INTERIOR EMERGENCY LIGHTING
(FAR § 121.310)

PROBLEM:

A quantity of aircraft do not meet the intent of FAR § 121.310 as to emergency lighting (Reference enclosed item from ARM-255).

STATUS.

ACTION:

DISCUSSION:

ARM-255 and AWS-330 provided a general overview of the subject agenda item. Solicitation was made to all regions relative to other types of aircraft with similar problems, and whether or not a national study should be initiated. AWS-330 indicated provision would be made to supply a national policy letter, which would be included in this report.

CONCLUSION.

No further action.

ARM-255

AGENDA ITEM

SUBJECT: Interior Emergency Lighting (FAR 121.310)

DISCUSSION: It has been found that some aircraft do not meet the intent of FAR 121.310 as to emergency lighting. The intent of the regulation is that the emergency lighting should be able to be turned on by the switch position in the rear of the aircraft regardless of the position of the switch in the cockpit. As a result, a national notice has been published, but this notice only applies to the CV-340/440/580 aircraft. We believe that other aircraft such as the DC-8 and DHC-7, and maybe others, do not meet the intent of FAR 121.310. We also believe that asking for voluntary compliance with the regulation by the operator will not be adequate in obtaining changes.

RECOMMENDATION: A directed safety investigation of all types of aircraft be conducted to determine the method of light operation and that an Airworthiness Directive be published as necessary to obtain compliance.

September 20, 1979

AWS-331C
AWS-331C

Notice N 8320.231, Emergency Lights - Convair 240/340/440/580/600; ARM-ACDO-31:8340-11-1 ltr (with enclosures) to ARM-250 thru ACDO-31 dtd 6/7

Acting Chief, Aircraft Maintenance Division, AWS-300

ARM-200

We have reviewed Frontier Airlines' June 6 correspondence concerning the CV-580 emergency light operation and the requirement of Federal Aviation Regulations (FAR) 121.310(d)(2)(i) and we offer the following:

We are unable to concur with Frontier Airlines' position that their CV-580 emergency lighting system meets the requirement of FAR 121.310(d)(2)(i). We believe that Preamble 121-30 makes the point that FAR 121.310(d)(2)(i) requires a "failsafe" operation. This type of operation precludes the reliance by the flight attendant on the flight crewmember's positioning of the emergency lighting switch to the arm mode which will enable the flight attendant to turn on the emergency lighting system.

We suggest you coordinate this matter with your regional counsel on the most appropriate manner to advise the air carrier that the present emergency lighting system does not satisfy the requirements of FAR 121.310(d)(2)(i).

This letter has been coordinated with the office of the General Counsel.

/s/

ROBERT D. BLACKER

4 Enclosures:
AWE-130 ltr to General Dynamics dtd 4/27
AWE-100 ltr to AFS-100 dtd 4/19
Ltr. from Mr. Trusk, FAA Coordinator, to AWE Aircraft Engineering Division dtd 3/29
Ltr. from AWS-130 to General Dynamics, Attn: Mr. Trusk dtd 3/7

cc: ANW-200; AWE-200; AGC-20; ARM-7
AWS-300/340/330S&DF
AWS-331C:Sarich:brj:X63440:9/10/79
File No. 8320.33
MC: None

To AWS-3.. 9/19 BD

To ... 9/13 ...

AWS-330
Dry

September 19, 1979

AWS-331C

Emergency Lights - Convair Aircraft - Reference Notice N 8320.231 dtd 5/1/79; AGL-230 (AGL-265:ATA-33) ltr dtd 7/13

Acting Chief, Aircraft Maintenance Division, AWS-300

AGL-200
Attention: AGL-260

This is in reply to your request for an agency position regarding compliance with Federal Aviation Regulations (FAR) 121.310(d)(2)(i) concerning emergency lights on Convair 240/340/440/580 and 600 aircraft.

We are unable to concur with the Minneapolis Air Carrier District Office's and Republic Airlines' postions that an approved checklist item and the use of an amber light which alerts the flightcrew that the emergency lighting system is in the disarm mode provides an equivalent level of safety. We believe that Preamble 121-30 makes the point that FAR 121.310(d)(2)(i) requires a "failsafe" operation which precludes the reliance by the flight attendant on the flightcrew member's positioning of the emergency lighting switch to the arm mode which will enable the flight attendant to turn on the emergency lighting system.

We suggest you coordinate this matter with your regional counsel on the most appropriate manner to advise the air carrier that the present emergency lighting system does not satisfy the requirements of FAR 121.310(d)(2)(i).

This letter has been coordinated with the office of the General Counsel.

/s/

ROBERT D. BLACKER

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AWS-130 ltr to General Dynamics dtd 4/27
AWS-100 ltr to AFS-100 dtd 4/19
Ltr. from Mr. Trusk, FAA Coordinator, to AWS Aircraft Engineering Division dtd 3/29
Ltr. from AWS-130 to General Dynamics, Attn: Mr. Trusk dtd 3/7

To AWS-330 9/19/79

cc: AGC-5; AWS-300/340; AGL-7
AWS-330S&DF
AWS-331C:Sarich:brj:X63440:9/7/79
File No. 8320.33 MC: None

20.0 NAVIGATION

AGENDA ITEM 20.1
RNAV SYSTEMS/AC 90-45A REVISION

PROBLEM:

RNAV systems installation/update for technical performance and airworthiness guidance (reference 1977 Agenda Item 10 and enclosed items from ACE-210 and AGL-255).

STATUS.

AWS-130 reviewed proposed AC 20-XX and the airworthiness portion of AC 90-45A. After coordination with RTCA, the AC publication will be reconsidered. (No written comments were received from regions).

ACTION.

AWS-130 proposed an AC 90-45B, which would include AC 20-XX type information/material.

DISCUSSION:

AGL-255 and ACE-210 agenda items were reviewed. AWS-130 provided the current status of the RTCA SC-133 RNAV. Minimum Operational Performance Standards (MOPS) development and proposed revision to AC 90-45A. AFO-512 provided a draft AC 20-XX "Installation approval of VOR/DME Dependent Area Navigation Systems" for review and comments.

Investigation is in progress whether or not the balance of the AC 90-45A information (that not in AC 20-XX) may be included in TERPS. AWS-343 regional survey indicates that previous RNAV interfacing problems have been solved. New system installations are not having interface problems based on current operations information. Inspectors need relief from a major modification requirement to a minor mod. status. There was a concern that going to a minor mod status appropriate limitations may be overlooked. VNAV is still considered a pilot aid, and is not required for ATC separation.

CONCLUSION:

All regions to review/comment to AFO-512 draft AC 20-XX by 1/80.

AGL-255

AGENDA ITEMS: Systems Workshop
October 1979/Orange County, California

SUBMITTED BY: AGL-GADO-5, Cincinnati, Ohio

SUBJECT: Reevaluation of RNAV Installation Approvals

BACKGROUND: Some RNAV system installations are becoming increasingly routine due to improved equipment design. RNAV equipment is now being manufactured that requires few installation adjustments. We are starting to see self contained systems which include the RNAV, VOR and DME in one unit.

Present STC and GADO approval of technical data is based on approving the RNAV system to a particular make and model aircraft. The operational capability of the RNAV is not significantly affected by the type of aircraft it is installed in.

With RNAV popularity on the upswing, Inspector workload has increased considerably.

RECOMMENDATION: Reevaluate our present criteria for approving RNAV installations to determine if all the systems being manufactured today require STC or GADO field approval.

ACE-210

WICHITA EMDO-43 AGENDA ITEM

SUBJECT: VNAV System Testing

BACKGROUND: This was a topic of discussion in previous workshops but no conclusions were established. Suggest this be discussed again.

DISCUSSION: The attached data defines the problem very well. The attached EMDO-43 telecon describes Central Region's position on the subject.

OPTIONS: N/A

RECOMMENDATION: Discuss and form a conclusion.

SUBJECT: VNAV System Testing

BACKGROUND: Table B in Appendix A of Advisory Circular 90-45A specifies allowable tolerances for the VNAV system. Some certification programs have required flight tests using theodolite or radar tracking.

DISCUSSION: System error can be determined using theodolite or radar tracking but there are other methods that provide the accuracy information adequate to show compliance.

If data is available on the static source position error, it can be combined with allowable altimeter error to obtain total altimetry system error. By inputing altitude information into the VNAV computer during bench tests, VNAV computer error can be determined. The altimetry and VNAV errors can then be combined to obtain the total system error. In this case only a functional (operational) flight test would be required, using some standard value for the pilot's ability to read the display and keep the airplane on the desired track.

If static source position error data is not available, it could be determined with a trailing cone or some other acceptable method. Then errors can be combined as before.

If bench test data is not sufficient, accuracy tests may be required. If static source error is known and a calibrated altimeter is used, an altitude reference can be established with the VNAV off. When the VNAV is turned on and pointers centered, the deviation from the reference altitude can be determined and that is the VNAV error. These various errors can then be combined to arrive at the total system error

The above procedures do not determine the additional dynamic error introduced while ascending or descending but the vertical error at the beginning waypoint and the vertical error at the final ascent or descent waypoint will provide an indication of the capability of the VNAV to perform satisfactory.

AVAILABLE OPTIONS:

1. Determine accuracy of altimetry system using available static source and altimeter accuracy data. Then use that as altitude reference information and eliminate the need for theodolite or radar tracking.

2. Determine accuracy using theodolite or radar tracking.

3. Determine static source error using trailing cone or other accpetable method and add published altimeter accuracy information to determine altimetry system error. Theodolite or radar tracking is not necessary for this test method either.

ALYSIS OF OPTIONS:

1. Option 1 - Is the easiest, cheapest, and more inclusive of all airplanes of of a given type than the other tests.
2. Option 2 - Is the next best way to test as far as costs to the applicant is concerned.
3. Option 3 - Is the costliest.

)ptions 2 and 3 provide data from one airplane only. Option 1 provides data gathered ıormally from several airplanes.

RECOMMENDATION: Functionally test system after analysis of accuracy data per Option 1. Test per Option 2 if data is not available for Option 1 - if the applicant is willing, and test per Option 3 only as a last resort.

-7-

TABLE I

ALTITUDE VS PRESSURE, AS PER NACA REPORT 1235

Equivalent Pressure MM	In.	Mb	Altitude Feet	Tolerance, Feet Room Temp.	* Low Temp.
787.87	31.0185	1050.41	-1,000	±20	—
760.00	29.9213	1013.25	0	20	±40
746.37	29.3846	995.08	500	20	—
732.93	28.8557	977.17	1,000	20	—
719.70	28.3345	959.52	1,500	25	—
706.65	27.8210	942.13	2,000	30	—
681.14	26.8167	908.12	3,000	30	—
656.38	25.8418	875.10	4,000	35	—
609.05	23.9782	811.99	6,000	40	60
654.51	22.2249	752.62	8,000	60	—
522.65	20.5769	696.81	10,000	80	—
483.34	19.0293	644.41	12,000	90	90
446.46	17.5773	595.24	14,000	100	—
411.90	16.2164	549.15	16,000	110	—
379.53	14.9421	506.00	18,000	120	120
349.25	13.7501	465.63	20,000	130	—
320.96	12.6363	427.91	22,000	140	—
282.04	11.1035	376.01	25,000	155	155
225.69	8.8854	300.89	30,000	180	—
178.83	7.0406	238.42	35,000	205	205
140.66	5.5380	187.54	40,000	230	—
110.62	4.3550	147.48	45,000	255	—
86.99	3.4247	115.97	50,000	280	280

* Allowable change from room temperature scale error test indication.

TABLE II

Tests	Reference Section	Tolerance Feet
Case Leak		±100
Position Error Test		20
Hysteresis		
First test Point 25,000		75
Second test Point 20,000		75
After Effect Test		30

SUMMARY OR REPRESENTATIVE VERTICAL GUIDANCE ERROR BUDGET IN FEET 99.7% (3σ)						
Error Source	*Final Approach 5000 feet MSL and below		*Terminal 10,000 feet MSL and below		Enroute (1) All altitudes	
	Level Flight	Ascent or Descent	Level Flight	Ascent or Descent	Level Flight	Ascent or Descent
Altimetry (3)	90	140	200	265	250	350
VNAV Equipment (4)	100	100	150	150	0 (2)	220
Flight Technical (5)	150	200	250	300	250	300
TOTAL RSS (3σ)	200	265	350	430	350	510

TABLE B

NOTE 1. Maximum operating altitudes to be predicated on compliance with total accuracy tolerance.
*When final approach and terminal area procedures are developed above altitudes shown, error is increased proportionately in the altimetry and RNAV parameters to provide airspace and obstacle clearance protection.

NOTE 2. In the event that VNAV guidance is used in level flight enroute the incremental error component contributed by the VNAV equipment must be offset by a corresponding reduction in other error components, such as flight technical error, to ensure that the total error budget is not exceeded.

NOTE 3. Altimetry Error. Refers to the electrical output and includes all errors attributable to the aircraft altimetry installation including position effects resulting from normal aircraft flight attitudes. In high performance aircraft, it is expected that altimetry correction will be necessary to meet these requirements. Such correction should be done automatically. In lower performance aircraft, upgrading of the altimetry system may be necessary. The larger errors shown for ascent/descent are typical of automatically corrected altimeter systems which meet the level flight error budget.

NOTE 4. VNAV Equipment Error. Includes all errors resulting from the vertical guidance equipment installation. Does not include

VOR/DME/TACAN STATION REFERENCED AREA NAVIGATION ERROR TABLE (95% PROBABILITY)

DISTANCE ALONG TRACK FROM TANGENT POINT

PERPENDICULAR DIST TO TANGENT POINT

	0	5	10	15	20	25	30	35	40	50	60	70	80	90	100	110	120	130	150	200
0 (x trk)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$\boxed{3.3}$	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$\boxed{[illegible]}$	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
80 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
90 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
100 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
110 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
120 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
130 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
140 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
150 (x trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(along trk)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PERP DIST

Tangent Pt — ALONG TRACK DIST

TO FIND THE CROSS-TRACK AND ALONG-TRACK ELECTRONIC SYSTEM ERROR (LESS PILOTAGE) AT A POINT, ENTER TABLE WITH PERPENDICULAR DISTANCE AND DISTANCE ALONG TRACK FROM TANGENT POINT, i.e., when the Perp Dist is 30 and the along-track dist is 50, the cross-track error is ±3.3 NM and the along-track error is 2.5 NM.

ERROR ELEMENTS

GROUND

VOR	1.9°
DME	0.1 NM

AIRBORNE

VOR	3.0°
DME	3% or 0.5 NM
RNAV SYSTEM	0.5 NM
PILOT	ZERO

TABLE 1

☐ VISIT ☐ CONFERENCE OR ☒ TELEPHONE CALL	TIME 1330	DATE 9/27/78

PERSON(S) CONTACTED OR IN CONFERENCE AND LOCATION

	ROUTING SYMBOL	INITIALS
Conference Call: Bob Huhn, AFS-130, E. Tankesley, ACE-213,	43C	
Dale Vassalli, EMDO-43C, Bob Klapprott, EMDO-43C	43	

SUBJECT

Vertical Navigation (VNAV) Approval Restrictions

DIGEST

Bob Huhn was apprised of the fact that Beech Aircraft Co. requested an explanation why VNAV approval for the Sperry Tern 100 VNAV installation in their Model E90 could not be granted in view of the fact they have reportedly complied with AC 90-45A VNAV requirements. We requested AFS-130 comments. Bob Huhn reemphasized that VNAV approvals should not be granted without the restriction pertaining to use of the altimeter as the sole means for determining altitude but was uncertain of the details of "why not?" He suggested we contact Jim Treacy, ANW-213.

Jim Tracy was contacted this same day by Klapprott and Vassalli. It was Jim's opinion that approvals are not to be granted because of the uncertainty of the adequacy of AC 90-45A vertical navigation error budget relative to allowable TSO altimeter errors and the future 1000 foot separation planned by ATC. Jim believes the altimeter inaccuracies and position errors inherent in aircraft static systems are so great that compliance with AC 90-45A Table B error budgets is nearly impossible for most aircraft without static error correction systems.

426 8395

RD OF ☐ VISIT ☐ CONFERENCE OR [x] TELEPHONE CALL | TIME | DATE 9/27/78

NAME(S) OF PERSON(S) CONTACTED OR IN CONFERENCE AND LOCATION | ROUTING: SYMBOL | INITIALS

PAGE 2

SUBJECT

DIGEST

The merits of using calibrated altimeters, calibrated DME, and calibrated air data altimeter system with known position errors in lieu of theodolite instrumentation for vertical path determination was discussed with Jim. He agreed this method should be acceptable.

CONCLUSION:

Beech Aircraft has submitted data showing compliance with VNAV requirements of AC 90-45A utilizing the aforementioned calibrated system. However, they have not submitted data showing 3 sigma confidence level for the flight test data. The max operating altitude of the aircraft is 30,000 feet. The TSO-C10b altimeter errors and Part 43 Appendix E altimeter check requirement are such that when coupled with the position error the maximum error is well within the altimetry error budget of AC 90-45A Table B. Flight technical errors well within limits have been demonstrated. It appears that Beech has shown compliance with AC 90-45A (except for 3 sigma data).

RECORD OF [ ] VISIT [ ] CONFERENCE OR [X] TELEPHONE CALL

TIME	DATE
1330	9/27/78

NAME(S) OF PERSON(S) CONTACTED OR IN CONFERENCE AND LOCATION

PAGE 3

SUBJECT

DIGEST

In the event that Beech should request approval of the Sperry TERN 100 system to AC 90-45A requirements (without the restriction to use the altimeter for primary altitude information except for MAP for RNAV Approaches) we feel confident that such approval can be granted. We plan to proceed accordingly unless directed otherwise. We realize that this approval will not provide Beech Aircraft with any increased operational flexibility because 1000 foot separations are not presently being adopted into the ATC system.

Until AC 90-45A is cancelled or revised we are obligated to honor an applicant's request for approval to these guidelines.

cc: Jim Treacy -- ANW-213

Bob Huhn -- AFS-130

E. Tankesley -- ACE-213

DATE	TITLE	SIGNATURE
10/5/78	Chief, Systems Unit	Bob Klapprott ROBERT L. KLAPPROTT

FAA Form 1360-33 4-75, FORMERLY FAA FORM 1522

October 1979

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AC 20-XX

DATE

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: INSTALLATION APPROVAL OF VOR/DME DEPENDENT AREA NAVIGATION SYSTEMS

1. PURPOSE. This advisory circular states an acceptable means, but not the only means, for obtaining approval of airborne area navigation systems for use in the U.S. National Airspace System. The information provided herein confines itself to the characteristics and functions considered necessary for certification of lateral guidance (2D) VOR/DME or DME/DME systems. Vertical guidance (3D) functions are only considered in the context of a nonrequired pilot aid, and all accuracy requirements refer to that utilization.

2. REFERENCES. Federal Aviation Regulations 23.1301, 23.1309, 23.1431, 23.1581, 25.1301, 25.1309, 25.1431, 25.1581, 27.1301, 27.1309, 27.1581, 29.1301, 29.1309, 29,1431, and 29.1581.

ALSO: RTCA SC-137 RNAV MOPS & DO-160 DEF. RQM'TS

3. DEFINITIONS. For the purpose of this advisory circular, the following definitions apply:

a. Along-Track Distance (ATD) Fix - The ATD fix is an along-track position defined with reference to a waypoint.

b. Along-Track Error - An error along the flight track resulting from the total error contributions of the airborne and ground equipment only.

c. Area Navigation (RNAV) - A method of navigation that permits aircraft operations on any desired course within the coverage of station referenced navigation signals. In addition, RNAV utilizing capabilities in the horizonal plane only is 2D while RNAV which also incorporates vertical guidance is 3D (VNAV).

d. Area Navigation (RNAV) Equipment - Airborne equipment that provides for area navigation.

e. Course Setting Error (CSE) - Errors resulting from the inability of the pilot or system to precisely set the exact desired course.

Initiated by:

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f. Cross-Track Error - An error to the left or right from the desired course to the present position, measured perpendicular to the desired course. This error includes airborne equipment, ground equipment, CSE, and FTE.

g. Desired Course - A predetermined or desired route or direction to be followed, measured in degrees with respect to a geographic reference position.

h. Flight Technical Error (FTE) - The accuracy with which the pilot controls the aircraft as measured by his success in causing the indicated aircraft position to match the indicated command or desired position.

i. Parallel Offset Route - A desired parallel course to the left or right of the designated route specified in nautical miles.

j. Reference Facility - The ground VOR/DME facility used for the identification and establishment of an area navigation route, waypoint, or flight procedure.

k. Root-Sum-Squares (RSS) - A geometric combination method used to combine static error standard deviations.

l. Slant Range - The actual distance between aircraft in flight and certain air navigation aids (VOR, DME). This distance is greater than the geographical range because of the altitude of the aircraft.

m. Slant Range Error - Slant range error is the difference between the distance of an aircraft to a point on the surface and the distance from that point along the surface to a point directly beneath the aircraft.

n. Tangent Point - The point from which a line perpendicular to the RNAV route centerline passes through a specified VORTAC.

o. Tangent Point Distance (TPD) - Distance from VORTAC to tangent point.

p. Track - The actual path of the aircraft over the surface of earth.

q. Track Angle - Setting used in station referenced RNAV systems to identify prescribed routes and tracks over the ground from point to point.

r. Vertical Navigation (VNAV) - That function of RNAV equipment which provides guidance in vertical plane.

s. Waypoint - A geographical position used for route definition and/or progress reporting purposes that is defined relative to a VORTAC reference facility.

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ADD STATEMENT RELATIVE TO → RTCA RNAV MOPS & DO-160 SYSTEM REQM'TS

4. ACCEPTABLE MEANS OF COMPLIANCE (FOR USE UNDER INSTRUMENT FLIGHT RULES).

a. System Accuracy Requirements.

(1) 2D RNAV System Using Reference Facility For Continuous Navigation Information.

(i) Systems to be used for enroute and terminal area operation. The total of the error contributions of the airborne equipment and all other horizontal error sources, when combined RSS, should not exceed the error values shown in table 2.

(ii) Systems to be used for RNAV approaches should meet the criteria for enroute and terminal operation and, in addition, should not exceed the error values shown in table 3.

(2) 2D RNAV Systems which use VOR/DME information from other than the reference facilities should show that the algorithm used will always select a station that will provide cross-track/along-track errors equal to or less than the RNAV system errors of the reference facility for any RNAV track.

(3) 3D RNAV Systems. VNAV capability is not considered a minimum requirement for area navigation, and it will not be used by ATC for vertical separation. However, it will be used as a nonrequired pilot aid, and minimum accuracies should be met to insure safe operation in the national airspace system. The minimum VNAV Equipment Error accuracy requirements are stated in table 4.

b. System Functional Requirements. Each area navigation system should satisfy the following criteria:

(1) Position Determination. The RNAV System should be capable of computing the aircraft position relative to a selected VORTAC (NAVAID) or in a latitude/longitude reference system.

(2) Manual Data Input. It should be possible for the pilot to enter data manually. The input device should be simple to operate and should not impose an excessive workload.

(3) Data Validation. It should be possible for the pilot to observe, validate, and correct any stored data. Data recall from storage for validation purposes should be a non-destructive readout.

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(4) Manual System Control. It should be possible for the pilot to manually control system functions such as reference facility and waypoint selection.

(5) System Displays. The system should provide a means of displaying to the pilot the following information:

(i) Computed aircraft position in terms of range and bearing to or from the active waypoint.

(ii) Cross-track error.

(iii) A positive indication of currently selected operating mode.

(iv) The waypoints selected and the waypoints available for selection.

(6) Response Time. The navigation display should indicate aircraft position to the accuracy specified in paragraph 4a, assuming that navigation sensor outputs are available:

(i) During flight in any direction at the maximum ground speed declared by the equipment manufacturer.

(ii) During ascent or descent at the maximum rates declared by the equipment manufacturer.

(iii) Within five seconds after any normal maneuver.

(iv) The time lag between time of data input and the availability of displayed guidance data should not be operationally significant.

(7) Failure Warning. The RNAV and VNAV equipment should provide warning to alert the pilot of system failure, accuracy degradation, or loss of required input signals.

(8) System Operation Test. A preflight and inflight test capability should be provided to verify system status.

c. System Installation Requirements.

(1) Location of Displays and Controls. System controls and data display should be visible to, and conveniently accessible to, the pilot with the least practicable deviation from his normal position and his line of sight when he is looking forward along the flight path.

(2) Failure Protection. Any probable failure of the airborne area navigation system should not degrade the normal operation of the equipment connected to it.

(3) Radio Frequency Interference. The area navigation equipment should not be the source of objectionable radio frequency interference or be adversely affected by radio frequency interference from other equipment in the aircraft.

(4) Environmental Conditions. The area navigation equipment should be capable of performing its intended function over the environmental range expected to be encountered in service.

(5) Aircraft Electrical Power Source. The area navigation equipment should be installed so that it receives its electrical power from a bus that provides maximum reliability for operation without jeopardizing service to essential or emergency loads.

d. Aircraft Flight Manual. If an aircraft flight manual is provided by the aircraft manufacturer, its FAA approved portion may contain the following information on the area navigation equipment:

(1) Normal procedure for operating the equipment;

(2) Equipment operating limitations; and,

(3) Emergency operating procedures (if applicable).

5. TESTING PROCEDURE (FOR EQUIPMENT PROVIDED FOR USE UNDER INSTRUMENT FLIGHT RULES).

a. General. An applicant for approval of an area navigation system installation in an aircraft may show that he has satisfied the criteria in paragraph 4 by a combination of bench tests of the individual components (including VOR and DME) and ground/flight tests of the entire installed area navigation system. The bench tests may have already been performed by the individual component manufacturer (during design and construction) or by the installer (on behalf of a previous customer). Such bench test data, if certified by the manufacturer or installer, is acceptable. In addition, the applicant may refer to applicable TSO standards, if the manufacturer of the equipment certifies that his equipment meets those standards.

b. Bench Tests. The following tests may be performed on the bench or with the navigation system installed in the aircraft:

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(1) Test equipment. Bench test equipment should be capable of simulating the perfect input signals from VOR/DME and/or the altimeter and of varying those signals over the ranges for which the equipment is designed.

(2) Static test. Horizontal and/or vertical position accuracy should be measured statically as the error in displayed position relative to the theoretical position obtained from perfect signal inputs (range and bearing from a known station location and/or altitude). Simulated range and bearing and/or altitude signals are introduced into the area navigation equipment. Combinations of ranges from zero up to the maximum distance for which the equipment is designed, bearings from zero to 360 degrees, and altitudes up to the maximum certificated altitude for the aircraft should be inserted as input signals. For each set of input signals, the corresponding display output should be compared to the theoretical position and recorded as an RNAV system error. The errors for each test point should then be combined statistically to determine the 2σ (95%) probable horizontal error and the 3σ (99.7%) probable vertical error. If the horizontal error exceeds ± 0.5 nautical miles, all horizontal error sources for the system, except flight technical error, should be combined by the RSS (route-sum-squares) method and compared to the values in table 1. The computed vertical errors should be compared to the values in table 4.

(3) Dynamic test. In addition to the static test, a dynamic accuracy test should be performed utilizing simulated VOR/DME and/or altimeter inputs varied in range, bearing and/or altitude in order to assess the ability of the system to smooth variable input signals without incurring excessive lag. These tests should be performed with representative simulated airspeeds throughout the range for which the equipment is designed. During these tests the measured RNAV equipment error should be consistent with the total system accuracies specified in paragraph 4. Alternatively, an in-flight demonstration of satisfactory dynamic characteristics may be accepted.

(4) Error Analysis. 2D RNAV System accuracy requirements, tables 1, 2, and 3, are derived from the following factors:

(i) Error Budget (2σ).

Ground VOR Facility	1.4 Degree
Ground DME Facility	0.1 NM
Airborne VOR Equipment	3.0 Degree
Airborne DME Equipment	0.2 NM + 1% of range
RNAV Equipment	0.5 NM
FTE Enroute and Terminal	1.0 NM
FTE Approach	0.5 NM
CSE	2.0 Degree

(ii) Error Combination Method. The root-sum-squares (RSS) method is used to combine the various 2σ (95%) probable error sources into a total system error.

$$\sigma Total = \sqrt{\sigma_1^2 + \sigma_2^2 .... + \sigma n^2}$$

Trade-offs in budgeted airborne elements is permitted provided the total system accuracy reflected in tables 1, 2, and 3 is met.

c. Ground/flight tests.

(1) Ground tests. After the area navigation system has been installed, but before the aircraft is flown, an operational/functional check should be performed to ensure that the system has been installed in accordance with the installation criteria in paragraph 4c (and with all applicable airworthiness regulations) and that it functions properly and safely.

(2) Determination of when flight tests are necessary. At least one flight test for accuracy in the approach case is necessary. Additional flight tests for accuracy are necessary if the system accuracy is not adequately determined by signal simulation as described in 5b(3) above, or if it appears that the resolution of the pilot display is such that the assumed FTE of 1.0 NM (enroute and terminal) or 0.5 NM (approach) will be exceeded.

(3) Accuracy tests in flight. The airplane should be flown solely by reference to the RNAV display and other standard flight instruments, at operational altitudes under VFR conditions, with a safety pilot and if possible under ground radar surveillance as follows:

Establish a waypoint at 10 NM TPD and 129 NM ATD (or maximum operational range for the equipment) and fly to a waypoint 10 NM TPD and 5 NM ATD on the other side of the tangent point, then enter a right hand racetrack pattern with a 40 NM leg length. Make a complete circuit of the racetrack and exit it along the same track on which entered and fly to a waypoint 10 NM TPD and 129 NM ATD from the station (or the maximum operational range of the equipment), see figure 1. Waypoint storage/recall, turn anticipation, direct to and parallel offsets should be exercised and the accuracy verified during this or subsequent flights. The VNAV functions of the equipment should be evaluated if the system is so equipped.

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The route should be structured such that it allows utilization of the above system functions along the route and in departure from the route for the purpose of flying at least one FAA approved Standard Terminal Arrival Route (STAR), one FAA approved RNAV approach and one Standard Instrument Departure (SID) and rejoining the previous route. Impromptu waypoints to aid in departing and rejoining the route and transitioning to and from the instrument procedures should be evaluated for ease of insertion/recall and procedural blunders.

During ascent and descent flight in terminal and/or final approach operation VNAV accuracy should be determined by theodolite observation or equivalent to check vertical angle performance. Final approach performance may be compared against ILS signals.

In each case, the area navigation system is satisfactory if the equipment meets the accuracy requirements of paragraph 4 as determined by direct visual reference or other suitable methods to identifiable ground check points and a large scale map of the area on which are shown route segment centerlines and boundary widths applicable to the distance from the reference facility.

(4) Functional test in flight. The area navigation system should be checked out in flight to determine whether the design and installation criteria in paragraphs 4b and 4c are satisfied.

6. ACCEPTABLE MEANS OF COMPLIANCE (FOR EQUIPMENT PROVIDED FOR USE UNDER VISUAL FLIGHT RULES).

a. An acceptable means of compliance with respect to area navigation systems provided for use under VFR conditions only is to satisfy the criteria in paragraph 4c and 5c(1) and to placard the aircraft to limit the use of the area navigation system to VFR only.

b. Airborne area navigation equipment installed under paragraph 6a may be approved by means of FAA Form 337, Repair/Alteration Data Form - Aircraft, Engine, Appliance, or Supplemental Type Certificate.

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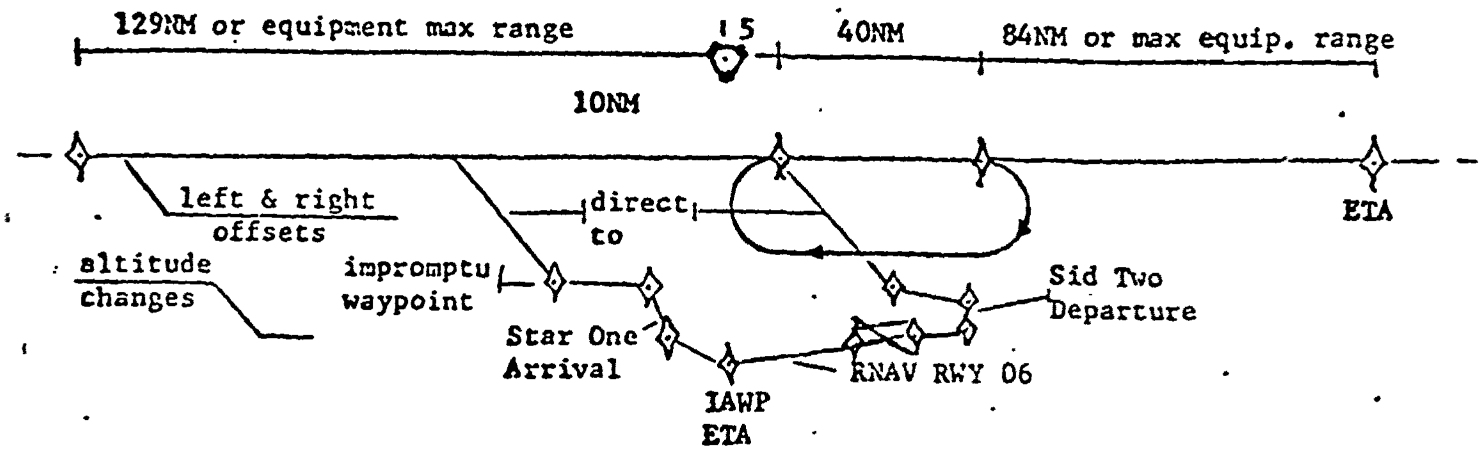

The system functions should be evaluated in a manner similar to that shown above, and as described in paragraph 2b. The specified flight path consists of the two 129NM route segments and the holding pattern. The remainder of the figure is only one of many that could be developed and is only intended as an example. The facility supporting the enroute segments need not be the one supporting impromptu waypoints or the instrument procedures.

FIGURE 1

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VOR/DME/TACAN STATION REFERENCED AREA NAVIGATION ERROR TABLE (95% PROBABILITY)

DISTANCE ALONG TRACK FROM TANGENT POINT

DISTANCE FROM TANGENT POINT TO VORTAC

	0	5	10	15	20	25	30	35	40	50	60	70	80	90	100	110	120	130	150
0(XTRK)		0.6	0.8	1.1	1.4	1.8	2.1	2.4	2.7	3.4	4.1	4.8	5.4	6.1	6.8	7.4	8.1	8.8	10.1
(ATRK)		0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.8
5(XTRK)	0.6	0.6	0.9	1.1	1.4	1.8	2.1	2.4	2.8	3.4	4.1	4.8	5.4	6.1	6.8	7.4	8.1	8.8	10.1
(ATRK)	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.9
10(XTRK)	0.6	0.7	0.9	1.2	1.5	1.8	2.1	2.4	2.8	3.4	4.1	4.8	5.4	6.1	6.8	7.5	8.1	8.8	10.2
(ATRK)	0.8	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0
15(XTRK)	0.6	0.7	0.9	1.2	1.5	1.8	2.1	2.4	2.8	3.4	4.1	4.8	5.4	6.1	6.8	7.5	8.1	8.8	10.2
(ATRK)	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.1
20(XTRK)	0.6	0.7	0.9	1.2	1.5	1.8	2.1	2.5	2.8	3.5	4.1	4.8	5.5	6.1	6.8	7.5	8.1	8.8	10.2
(ATRK)	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.3
25(XTRK)	0.7	0.8	1.0	1.2	1.5	1.8	2.2	2.5	2.8	3.5	4.1	4.8	5.5	6.1	6.8	7.5	8.2	8.8	10.2
(ATRK)	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.5
30(XTRK)	0.7	0.8	1.0	1.3	1.6	1.9	2.2	2.5	2.8	3.5	4.1	4.8	5.5	6.1	6.8	7.5	8.2	8.8	10.2
(ATRK)	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.7
35(XTRK)	0.8	0.8	1.0	1.3	1.6	1.9	2.2	2.5	2.8	3.5	4.2	4.8	5.5	6.2	6.8	7.5	8.2	8.8	10.2
(ATRK)	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.7	2.7	2.9
40(XTRK)	0.8	0.9	1.1	1.3	1.6	1.9	2.2	2.5	2.9	3.5	4.2	4.8	5.5	6.2	6.8	7.5	8.2	8.9	10.2
(ATRK)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.1
50(XTRK)	0.9	1.0	1.1	1.4	1.7	2.0	2.3	2.6	2.9	3.5	4.2	4.9	5.5	6.2	6.9	7.5	8.2	8.9	10.2
(ATRK)	2.9	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4	3.4	3.5	3.6
60(XTRK)	1.0	1.0	1.2	1.4	1.7	2.0	2.3	2.6	2.9	3.6	4.2	4.9	5.6	6.2	6.9	7.6	8.2	8.9	10.2
(ATRK)	3.5	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.8	3.8	3.8	3.9	3.9	4.0	4.1
70(XTRK)	1.0	1.1	1.3	1.5	1.8	2.1	2.4	2.7	3.0	3.6	4.3	4.9	5.6	6.2	6.9	7.6	8.3	6.9	10.3
(ATRK)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.2	4.2	4.2	4.3	4.3	4.4	4.4	4.4	4.5	4.5	4.6
80(XTRK)	1.1	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.7	4.3	5.0	5.6	6.3	6.9	7.6	8.3	8.9	10.3
(ATRK)	4.6	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.8	4.8	4.8	4.9	4.9	5.0	5.0	5.0	5.1	5.2
90(XTRK)	1.2	1.3	1.5	1.7	1.9	2.2	2.5	2.8	3.1	3.7	4.3	5.0	5.6	6.3	7.0	7.6	8.3	9.0	10.3
(ATRK)	5.2	5.2	5.2	5.2	5.3	5.3	5.3	5.3	5.3	5.3	5.4	5.4	5.4	5.5	5.5	5.5	5.6	5.6	5.7
100(XTRK)	1.3	1.4	1.5	1.7	2.0	2.2	2.5	2.8	3.1	3.7	4.4	5.0	5.7	6.3	7.0	7.7	8.3	9.0	10.3
(ATRK)	5.8	5.8	5.8	5.8	5.8	5.8	5.9	5.9	5.9	5.9	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.2	6.3
110(XTRK)	1.4	1.5	1.6	1.8	2.1	2.3	2.6	2.9	3.2	3.8	4.4	5.1	5.7	6.4	7.0	7.7	8.4	9.0	10.4
(ATRK)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.5	6.5	6.5	6.5	6.6	6.6	6.6	6.7	6.7	6.7	6.8
120(XTRK)	1.5	1.6	1.7	1.9	2.1	2.4	2.7	2.9	3.2	3.8	4.5	5.1	5.8	6.4	7.1	7.7	8.4	9.1	10.4
(ATRK)	6.9	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.1	7.2	7.2	7.2	7.3	7.3	7.4
130(XTRK)	1.6	1.7	1.8	2.0	2.2	2.5	2.7	3.0	3.3	3.9	4.5	5.2	5.8	6.4	7.1	7.8	8.4	9.1	10.4
(ATRK)	7.5	7.5	7.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.8	7.8	7.8	7.9	7.9
140(XTRK)	1.7	1.8	1.9	2.1	2.3	2.5	2.8	3.1	3.3	3.9	4.6	5.2	5.8	6.5	7.1	7.8	8.5	9.1	10.4
(ATRK)	8.1	8.1	8.1	8.1	8.1	8.1	8.2	8.2	8.2	8.2	8.2	8.3	8.3	8.3	8.3	8.4	8.4	8.4	8.5
150(XTRK)	1.8	1.9	2.0	2.2	2.4	2.6	2.9	3.1	3.4	4.0	4.6	5.2	5.9	6.5	7.2	7.8	8.5	9.2	10.5
(ATRK)	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.9	8.9	8.9	8.9	9.0	9.0	9.1

ERROR ELEMENTS

GROUND
VOR 1.4°
DME 0.1 NM

AIRBORNE
VOR 3.0°
DME 0.2 NM + 1.0%
CSE 2.0°

RNAV SYSTEM 0.5NM

PILOT ZERO

TABLE 1

ENROUTE & TERMINAL AREA FIX DISPLACEMENT ERROR (95% PROBABILITY)

DISTANCE ALONG TRACK FROM TANGENT POINT

DISTANCE FROM TANGENT POINT TO VORTAC

		0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
0	(XTRK)	1.1	1.3	1.8	2.3	2.9	3.6	4.2	4.9	5.5	6.2	6.8	7.5	8.2	8.3	9.5	10.2
	(ATRK)	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
10	(XTRK)	1.2	1.3	1.8	2.3	2.9	3.6	4.2	4.9	5.5	6.2	6.9	7.5	8.2	8.9	9.5	10.2
	(ATRK)	0.8	0.8	0.9	0.9	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
20	(XTRK)	1.2	1.4	1.8	2.4	3.0	3.6	4.2	4.9	5.5	6.2	6.9	7.5	8.2	8.9	9.5	10.2
	(ATRK)	1.3	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.3
30	(XTRK)	1.2	1.4	1.8	2.4	3.0	3.6	4.3	4.9	5.6	6.2	6.9	7.6	8.2	8.9	9.6	10.2
	(ATRK)	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.6	2.7
40	(XTRK)	1.3	1.5	1.9	2.4	3.0	3.6	4.3	4.9	5.6	6.3	6.9	7.6	8.2	8.9	9.6	10.3
	(ATRK)	2.4	2.4	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.0	3.1
50	(XTRK)	1.3	1.5	1.9	2.5	3.1	3.7	4.3	5.0	5.6	6.3	6.9	7.6	8.3	8.9	9.6	10.3
	(ATRK)	2.9	3.0	3.0	3.0	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4	3.4	3.5	3.5	3.6
60	(XTRK)	1.4	1.6	2.0	2.5	3.1	3.7	4.3	5.0	5.6	6.3	7.0	7.6	8.3	9.0	9.6	10.3
	(ATRK)	3.5	3.5	3.5	3.6	3.5	3.6	3.7	3.7	3.8	3.8	3.8	3.9	3.9	4.0	4.1	4.1
70	(XTRK)	1.4	1.6	2.0	2.6	3.1	3.8	4.4	5.0	5.7	6.3	7.0	7.6	8.3	9.0	9.6	10.3
	(ATRK)	4.1	4.1	4.1	4.1	4.2	4.2	4.2	4.3	4.3	4.4	4.4	4.4	4.5	4.5	4.6	4.6
80	(XTRK)	1.5	1.7	2.1	2.6	3.2	3.8	4.4	5.1	5.7	6.4	7.0	7.7	8.3	9.0	9.7	10.3
	(ATRK)	4.6	4.7	4.7	4.7	4.7	4.8	4.8	4.8	4.9	4.9	5.0	5.0	5.0	5.1	5.1	5.2
90	(XTRK)	1.6	1.8	2.2	2.7	3.2	3.8	4.5	5.1	5.7	6.4	7.0	7.7	8.4	9.0	9.7	10.4
	(ATRK)	5.2	5.2	5.3	5.3	5.3	5.3	5.4	5.4	5.4	5.5	5.5	5.5	5.6	5.6	5.7	5.7
100	(XTRK)	1.7	1.8	2.2	2.7	3.3	3.9	4.5	5.1	5.8	6.4	7.1	7.7	8.4	9.1	9.7	10.4
	(ATRK)	5.8	5.8	5.8	5.9	5.9	5.9	5.9	6.0	6.0	6.0	6.1	6.1	6.1	6.2	6.2	6.3
110	(XTRK)	1.7	1.9	2.3	2.8	3.3	3.9	4.5	5.2	5.8	6.5	7.1	7.8	8.4	9.1	9.7	10.4
	(ATRK)	6.4	6.4	6.4	6.4	6.5	6.5	6.5	6.5	6.6	6.6	6.6	6.7	6.7	6.7	6.8	6.8
120	(XTRK)	1.8	2.0	2.4	2.8	3.4	4.0	4.6	5.2	5.8	6.5	7.1	7.8	8.5	9.1	9.8	10.4
	(ATRK)	6.9	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.1	7.2	7.2	7.2	7.3	7.3	7.3	7.4
130	(XTRK)	1.9	2.1	2.4	2.9	3.4	4.0	4.6	5.2	5.9	6.5	7.2	7.8	8.5	9.1	9.8	10.5
	(ATRK)	7.5	7.5	7.5	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.8	7.8	7.8	7.9	7.9	7.9
140	(XTRK)	2.0	2.1	2.5	3.0	3.5	4.1	4.7	5.3	5.9	6.6	7.2	7.9	8.5	9.2	9.8	10.5
	(ATRK)	8.1	8.1	8.1	8.2	8.2	8.2	8.2	8.3	8.3	8.3	8.3	8.4	8.4	8.4	8.5	8.5
150	(XTRK)	2.1	2.2	2.6	3.0	3.6	4.1	4.7	5.3	6.0	6.6	7.2	7.9	8.6	9.2	9.9	10.5
	(ATRK)	8.7	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.1

ERROR ELEMENTS

GROUND		AIRBORNE			
VOR	1.4°	VOR	3.0°	RNAV System	0.5NM
DME	0.1NM	DME	0.2NM + 1.0%	Pilot	1.0NM
		CSE	2.0°		

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TABLE 2

DRAFT

COPY — FAA

FINAL AREA FIX DISPLACEMENT ERROR (95% PROBABILITY)

DISTANCE ALONG TRACK FROM TANGENT POINT

DISTANCE FROM TANGENT POINT TO VORTAC

	0	5	10	15	20	25	30
0 (XTRK)		0.8	1.0	1.2	1.5	1.8	2.1
(ATRK)		0.6	0.6	0.6	0.6	0.7	0.7
5 (XTRK)	0.8	0.8	1.0	1.2	1.5	1.8	2.2
(ATRK)	0.6	0.6	0.7	0.7	0.7	0.8	0.8
10 (XTRK)	0.8	0.8	1.0	1.3	1.5	1.9	
(ATRK)	0.8	0.8	0.8	0.8	0.9	0.9	
15 (XTRK)	0.8	0.9	1.0	1.3	1.6	1.9	
(ATRK)	1.0	1.0	1.0	1.1	1.1	1.1	
20 (XTRK)	0.8	0.9	1.1	1.3	1.6		
(ATRK)	1.3	1.3	1.3	1.3	1.3		
25 (XTRK)	0.8	0.9	1.1	1.3			
(ATRK)	1.5	1.5	1.6	1.6			
30 (XTRK)	0.9	0.9					
(ATRK)	1.8	1.8					

ERROR ELEMENTS

GROUND		AIRBORNE		RNAV SYSTEM	0.5NM
VOR	1.4°	VOR	3.0°		
DME	0.1 NM	DME	0.2NM + 1.0%	PILOT	0.5NM
		CSE	2.0°		

TABLE 3

DRAFT

COPY

VNAV EQUIPMENT MINIMUM REQUIREMENTS ERRORS IN FEET (99.7% PROBABILITY)					
FINAL APPROACH 5000 MSL AND BELOW		TERMINAL AREA 10,000 MSL AND BELOW		ENROUTE ALL ALTITUDES	
LEVEL FLIGHT	ASCENT OR DESCENT	LEVEL FLIGHT	ASCENT OR DESCENT	LEVEL FLIGHT	ASCENT OR DESCENT
100	100	150	150	10	220

TABLE 4

AGENDA ITEM 20.2
OMEGA/VLF ITEM

PROBLEM:

AC 20-101A: Verification and updating VLF equipment, antenna installations, and 8110.30 (Reference 1977 Agenda Item 9/14 and enclosed item from ANE-213).

STATUS.

1) Antenna installations. The antenna location details are such an art that no meaningful standard instructions were thought feasible at this time. An Order 8110.30 has been published describing Omega anomalies. A revision to update and correct some inaccurate information is in progress. A revision is in progress to correct some editorial errors, for 8110.30, AC 20-101 has been updated to AC 20-101A. RTCA review of DO-164 will incorporate antenna guidance.

ACTION:

Revision to 8110.30 is intended.

DISCUSSION: (Ref. Agenda Item F/S 2)

Order 8110.30 is in coordination with AFO-200 (Jerry Davis). AC 20-101A has a limited quantity of esthetic errors which do not need revision (i.e., big vs VHF etc.). RTCA has approved DO-164 revision (DO-164A) with appropriate antenna instructions, and other information. DO-164A will be available in the near future.

The ANE-213 agenda item was discussed, and the concensus opinion indicated that the annuniation must be within normal vision (without turning head) and may be located on the instrument panel or pedestal. It was recommended that the CDU be located forward of the throttle quadrant, but if located on the pedestal a remote annunciation or light may be required.

CONCLUSION:

No further action.

ANE-213

JOINT WORKSHOP DISCUSSION

SUBJECT: Annunciation of VLF Dead Reckoning Mode.

BACKGROUND: AC20-101A requires verification and updating VLF equipment after operating in the dead reckoning mode.

DISCUSSION: Most VLF equipment will enter the dead reckoning mode and annunciate this condition on the control panel. After resuming the normal mode, the annunciation will automatically disappear without any indication that the equipment has been in the dead reckoning mode. In order to perform his required verification and updating, the pilot must know when his VLF equipment is in or has been in a dead reckoning mode.

AVAILABLE OPTIONS :

1. Require the VLF control panel to be on the instrument panel in full view of the pilots.

2. Require the VLF equipment to have a hold circuit for the dead reckoning mode annunciators.

3. Require a remote annunciator to be installed on the instrument panel.

4. Establish a uniform criteria to be used by all regions in evaluating the location of dead reckoning mode annunciators.

ANALYSIS OF OPTIONS:

1. Too restrictive

2 &
3. Viable alternatives if the control panel cannot be installed in an acceptable location. Would require modifications to the VLF equipment.

4. Best solution which would provide consistency among the regions and could be implemented immediately.

RECOMMENDATION : Develop criteria at the workshop for the location of the VLF control panel/dead reckoning mode annunciator.

Submitted by:

R. L. Vavruska

RONALD L. VAVRUSKA, ANE-213E

AGENDA ITEM 20.3
OMEGA TIA's, COMMENTS, GUIDANCE

PROBLEM:

Various problems, comments, guidance, etc. Omega/VLF (reference 1977 Agenda Item 15 and enlcosed items from AWE-130 and ASW-210.

STATUS:

AWS-130 reviewed AWE-130 Omega package along with other regions' antenna guidance information. No comments were received supportive or nonsupportive to the rather comprehensive package by AWE-130. AWS-130 considers the Western Region approach acceptable and recommends the regions utilize it as general guidance and adapt as appropriate. Regarding sole means of Navigation AC 120-37, AFO-512 is reviewing comments received from AWE-130.

ACTION:

Workshop will be utilized to review current Omega and Omega/VLF status.

DISCUSSION:

AWE-130, ASW-210, and AWS-130 discussed each of three parts of Agenda Item (AI) 20.3 enclosed. The first AI discussed, relationship to AC 120-37 and the need to revise the AC to reflect the "Navigation error of $\pm$ 20 NMI cross track" to +15NMI. The AC should be rephrased to state ". . . . two heading inputs and two airspeed (AS) inputs . . ." (not two compass inputs and two TAS inputs). Concensus supports deselection of two most critical stations, but if applicant chooses more than two stations for deselection, he may demonstrate. Normally, the FAA evaluates to published criteria, but if no published criteria is available, then the manufacturers stated specifications will be used on deselection. It was suggested that it would be beneficial to the regions if a policy letter were available.

Notice, that either manual or automatic deselection may be utilized on the Liberian Station. It was identified, that all Omega manufacturers have station geometry problems.

NOTE: Original Omega AC's requested STC approval, due to the Omega environment unknowns. If the Regions develop coordinated procedures (as identified in Agenda Item 4.1) which have established confidence that limitations and AFM supplements are being appropriately handled, then it is the Regions perogative to approve other than by an STC.

CONCLUSION:

AFO-512 to revise AC 120-37 to indicate heading, airspeed, and +15NMI crosstrack inputs by 2/80. AWS-130 to develop a deselection policy letter by 3/80.

AWE-130

AGENDA ITEM

ACCURACY CRITERIA OF OMEGA AC 120-37 ARE NOT REALISTIC

SUBJECT

AC 120-37 defines the required navigation accuracy for long range navigation anywhere in the world as that stipulated by TSO C-94 or FAR 37.205. TSO standards are basically laboratory criteria and often do not reflect "real world" conditions. TSO C-94 calls for an accuracy of ± 10 NM with a 95% confidence level. It is suggested that this navigation accuracy is too stringent a requirement for long range navigation, especially since lane separation is wide enough not to require it.

DISCUSSION

The narrowest, oceanic lane separation is found across the North Atlantic Track; 60 NM. Anywhere else in the world, oceanic lane separation is 120NM. Additionally, Omega was designed to produce the best signal coverage and consequently the best accuracy in the North Atlantic. The ICAO specifications (NAT MNPS), which are reflected in AC 120-33, call for an accuracy of ± 12.6 NM with a 95% confidence level across the North Atlantic Track. It does not make good sense to require greater navigation accuracy when flying on other than North Atlantic routes.

PROPOSAL

FAR 121, Appendix G, allows a navigation error of ± 20 NM cross track and ± 25 NM along track with a 95% confidence level for long range navigation equipment. It is suggested that for flights outside the North Atlantic Track the navigation accuracy for Omega be opened up to ± 20 NM with a 95% confidence level.

AWE-130

AGENDA ITEM

REDUNDANCY CONSIDERATIONS FOR OMEGA OR OMEGA/VLF-COM NAVIGATION SYSTEMS

SUBJECT

AC 120-37 requires a dual Omega installation when approving Omega as sole means of long range, transoceanic navigation. Different from INS and Doppler, Omega is not a self-contained system. In addition to radio signals, Omega depends on outside sensor inputs such as velocity (TAS) and magnetic compass (heading) for proper system function. TAS and heading are needed for "rate-aiding" and the dead reckoning mode. Examination of the Omega transmissions format reveals a duty cycle of 10%, or in other words; a position fix is available only once every ten seconds. To produce a continuous steering signal the rate-aiding function is employed. Rate-aiding is, in essence, a dead reckoning mode. AC 120-37 defines a dual Omega installation as: "A dual Omega installation includes two receiver processor units (2 RPUs), two control display units (2 CDUs) and two antenna units (2 AUs)"; but no mention is made regarding two TAS and two heading inputs.

DISCUSSION

Aircraft intended for use of long range, transoceanic navigation normally do have two compass systems; consequently there are no problems to provide two compass inputs for a dual Omega installation. However, a considerable number of aircraft do not have any TAS system. Installation of two TAS systems is quite expensive, and many modifiers refuse to install two TAS systems, because it is not a requirement of the FARs nor is it a requirement of the Advisory Circular.

OPTION 1

Change the Advisory Circular and make two compass and two TAS inputs mandatory.

OPTION 2

Leave the Advisory Circular as is.

OPTION 3

Rephrase the A.C. as follows: "A dual Omega installation includes two RPUs, two CDUs, two AUs, two compass inputs and two TAS inputs. One single TAS input may be utilized provided it can be demonstrated that no degradation in system accuracy and reliability will occur."

ANALYSIS OF OPTIONS

Option 1 is too restrictive and may penalize the installer of an Omega system which does not rely (heavily) on TAS input.

Option 2 does not obviate the problem of how to handle TAS.

Option 3 is recommended by the Western Region. It is possible to design Omega systems which may not require a TAS input to accomplish the rate-aiding function. This may be done by relying on VLF-Com or by sacrificing signal amplitude (about 6 db) vs. rate-aiding in the tracking filter. In any event, TAS may be inserted manually when the automatic TAS source fails. The flight crew would make a quick calculation of TAS and enter it

into the CDU manually. Accuracy of TAS is not critical. Most Omega systems will function satisfactorily if TAS is within 50 knots of real value.

Admittedly, the dead reckoning mode will not function without TAS input. However, a double failure must occur in order that dead reckoning navigation will not be available; 1) signal transmission failure; 2) TAS input failure.

ASW-210

VLF/Omega Approvals

Background: There is a considerable amount of guidance material out for approval of VLF/Omega systems. The preponderance of this material is for operational approvals, i.e., AC 20-101; AC 120-33; 91-49; 120-31A; and AC 120-37. In addition, there is material in the form of letters from AFS-100 (i.e., June 16, 1978) and Order 8110.30. Methods of compliance with some of the points brought out in this material need clarification.

Discussion: VLF/Omega installations have become commonplace. As they are being utilized more and more as sole means of navigation, the problems, anomalies and test procedures previously utilized need to be re-evaluated.

The June 16, 1978, letter from AFS-100 contained, among other things, the instruction to require deselection of the two strongest Omega stations during the flight test of the system. It would appear that the number "two" is rather arbitrary and perhaps should be reconsidered. Perhaps the deselection of only one would be adequate. On the other hand, if the manufacturer claims his device will perform properly on two, three or some other specified number of stations, perhaps the accuracy tests should be made with the minimum number of stations being utilized.

There are at least three anomalies that should be discussed and the action to be taken spoken to. 1) The approximately 300 mile limit inside of which the station is so strong that it derogates the other stations being received, 2) the problem with the Liberian station (insofar as the shift problem when there is a diurnal shift between the station and the user), and, 3) the problem of station geometry in relation to the receiving aircraft. Combinations of these anomalies may cause relatively large navigation errors without annunciation to the crew on at least some systems.

Available Options: The deselection question and each of the three anomalies mentioned will be addressed separately.

1. There are several options available relating to deselection of stations for official flight tests. NOTE: We are speaking to pure Omega systems. If the system utilizes VLF/Omega, we see no reason to require any deselection.

   (a) Do not require any deselection.

   (b) Require deselection of only the strongest usable station.

(c) Continue to require deselection of the two strongest stations.

(d) Require applicant to show compliance with the requirements with the minimum number of stations he claims proper functioning with.

2. The approximate 300 mile limit within which other stations are derogated.

(a) Require action by crew by information in limitations section of AFM.

(b) Provide information to the crew in operations section of AFM.

(c) Require software changes that automatically deselect at a predetermined distance.

3. Problems with Liberian station.

(a) Provide information in the operations section of the AFM.

(b) Require action by the crew by information in the limitations section of the AFM.

(c) No action required.

(d) Incorporate software to deselect when station provides questionable signals.

4. Problem of station geometry.

(a) Provide information in the operations section of the AFM to alert the crew of the possibilities.

(b) Require action by the crew by information in the limitations section of the AFM.

(c) Require that the system software prevent use of the stations in this configuration.

(d) Require annunciation to the pilot when unacceptable navigation errors are caused.

nalysis of
Options: 1. Deselection of stations for flight test.

(a) It is recognized that station outages will occur through scheduled or unscheduled shutdown. Therefore, not requiring any deselection is not a valid solution.

(b) Deselection of only the strongest usable station has a great deal of merit. To fully determine whether this would be adequte, a probability analysis plus a safety effects analysis of the loss of one, two, or more stations should be conducted.

(c) Continuing to require deselection of two stations would be the easiest since no new policy would be required.

(d) In general, we require that a system function when installed. Most often the manufacturer or installer defines what the intended function is. Using this philosophy, it would appear that the accuracy data should be obtained with only the minimum number of stations needed (as claimed by the applicant and shown in his data) being utilized.

2. Close proximity to station.

(a) & (b) Utilization of the AFM to provide required action or merely information is a viable concept. Nevertheless, the continued proliferation of information in AFM's results in a less usable document. It would seem that use of automatic deselection would negate added pilot action. On the other hand, automatic deselection deletes a pilot alternative that could be highly desirable under some conditions.

(c) Software changes to automatically deselect stations at predetermined distances, signal strengths, or other criteria can be accomplished. As mentioned in (a) & (b) above, this solution is a trade-off between less pilot work load and a more flexible system. Additional flexibility could be obtained by requiring a system whereby the crew can override the deselection.

3. Problems with Liberian station.

(a), (b), & (c) (The first three alternatives will be considered together.) We believe that some action is necessary, thus alternative "c" is rejected. The inclusion of information in the AFM to inform the crew when the utilization of the

Liberian station may cause erroneous navigation is the very least that should be required. This alternative could mean a significant addition to the crew workload as well as give the opportunity for error.

(d) The inclusion in computer programming all of the times and geographic locations wherein the acceptability of the station is questionable and either deselecting it or annunciating to the crew that it is questionable appears to be a viable solution that provides less workload and less opprotunity for error.

4. Problem of station geometry.

(a) & (b) Merely providing information to the crew by use of the AFM (even in the limitations section) does not adequately correct a hazardous situation. Nonetheless, information regarding this problem should be included in the AFM.

(c) & (d) We believe that one or the other of these two options is most desirable. It could well be that you may want navigation information with a normally unacceptable error available to you rather than having no navigation at all. Nevertheless, the fact that the navigation information is in error must be known by the crew by at least annunciation.

Recommendations:

1. Deselection of stations for flight test.

We recommend that the system be flight tested while using the minimum number of stations that the installer/modifier claims to be required. This information should be placed in the limitations section of the AFM and some sort of annunciation made to the crew when not to use the system for navigation.

2. Close proximity to station.

We believe option "c" is appropriate and provides the most flexible system with minimum added workload and still eliminating a problem.

3. Liberian station at night.

We believe that item "d" is appropriate. It eliminates workload and much opportunity for human error and forgetfulness.

4. Station geometry.

We believe that "d" is probably the most desirable since it would alert the crew to error but retain information for emergency usage.

AGENDA ITEM 20.4
LORAN C. ACCURACY/COVERAGE PROBLEMS

PROBLEM:

Special accuracy/coverage considerations for problem Loran-C geographic areas (reference enclosed item from ASW-210).

STATUS:

ASW has approved Loran-C for use (by helicopter) in the Gulf Offshore Operations where the accuracy/coverage grid is acceptable.

ANE has received application for enroute/approach to five airports.

U.S.Air (Alleghany) data not available, as system is not being used.

FAA Gulf & Northeast Corridor data to be available in the near future from ARD-300 for regional use in Loran-C approval deliberations.

ACTION:

DISCUSSION:

General discussion by ASW-210 relative to Loran-C problems. Helicopter operation involve two primary Teledyne systems (Models 711 & 424). The Model 711 (economical version) is causing greatest problems. Briefing conducted by ARD-300 relative to the FAA Gulf Flight Tests & Coast Guard Northeast Corridor Data. ASW participated and received a draft copy of the data. The ARD presentation contained a audio-visual cassett which is a general Loran-C overview and status. Cassett and data available to Regions.

A quantity of Air Carrier single Loran-C operations on the East Coast. A suggestion that AWS-330 solicit U.S.Air Loran-C experience/ data availability. Some regions have TSO'd Loran-A & C combined, with Loran-C handled as a major modification (STC).

CONCLUSION:

Order 8110.33 dated 11/13/78 is the current guidance. AWS-130 to coordinate Loran-C data and cassett presentation availability with ARD-300 by 12/79.

AWS-330 to attempt to determine availability of U.S.Air (Alleghany) data by 1/80.

ASW-210

LORAN C - ACCURACY/COVERAGE PROBLEMS

Background: This region has two STC projects to install Teledyne TDL-711 Loran C equipment in Bell helicopters. There is a problem with the accuracy/coverage of this system in the Gulf of Mexico. We understand that NAFEC is involved in flight testing a Loran C system on a Convair 580 aircraf' in the Gulf of Mexico. These tests will also investigate reported transmission line interferences.

Discussion: The TDL-711 system can receive from only two (2) ground chains. One is primary and the other is alternate. An accuracy/coverage problem exists in the Gulf in that when Malone is the master station and Jupiter and Grangeville are the slave stations (primary chain), only the eastern portion of the Gulf can be used (see Figure 2). For the alternate chain, Malone is the master and Raymondsville and Grangeville are the slaves and the western portion of the Gulf can be used (see Figure 3).

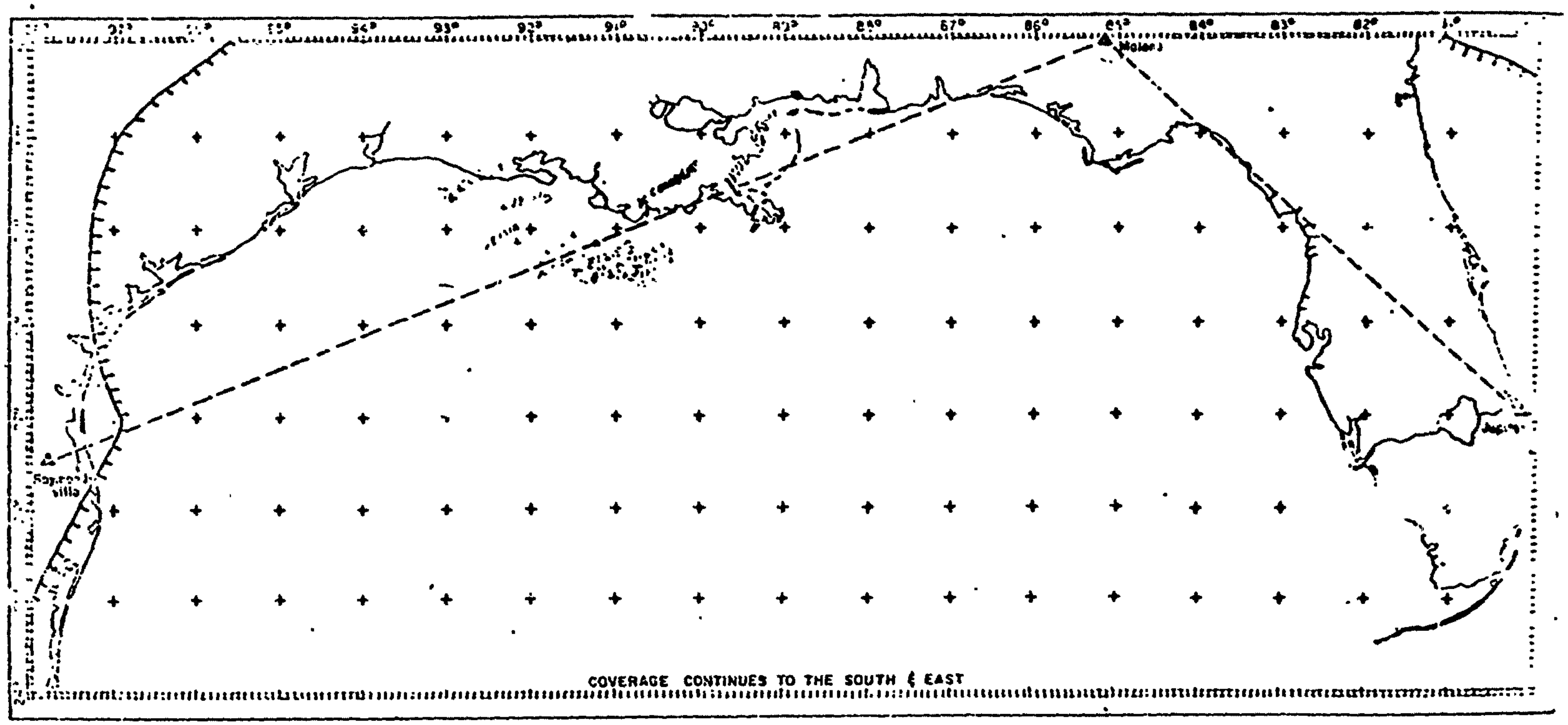
Accuracy data thus far submitted was all obtained from an area approximately 50 miles by 100 miles off the coast of New Orleans (see Figure 1). We have requested additional accuracy data from all areas of the Gulf Coast using the Gulf Coast chains. This data is still incomplete. The accuracy of the data submitted so far does not comply with AC 90-45A.

The above means that the approvals will be tied to the Gulf chain only and for a specific geographic box for these STC's provided proper accuracy is ultimately demonstrated.

Earlier in the programs, the Atlantic Coast chain was utilized for Gulf navigation. The accuracy results were not acceptable. The applicant attempted to show that excellent accuracy could be obtained by using a bias chart in navigating to a point previously plotted on the bias chart. Order 8110.33, "Loran C Interim Airworthiness Guidelines," came out some time ago. It prohibited the use of bias charts to determine basic accuracy except for a very limited special flight authorization (i.e., to offshore oil rigs).

2

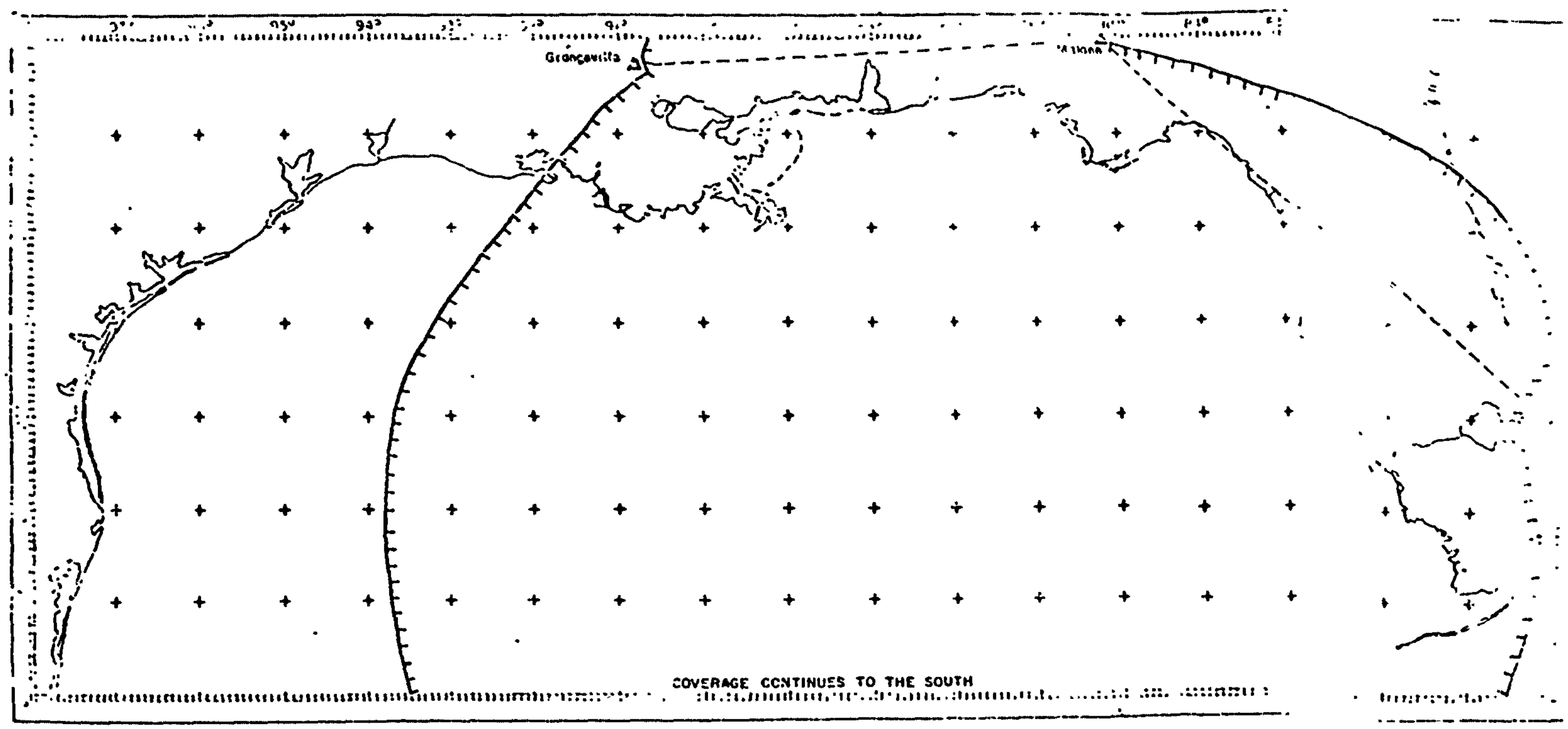
Recommendation: (This problem does not fit the "available option"/"analysis" format requested.) We recommend that guidance material be provided: 1) Permitting approvals in an area identified by specific geographic boundaries, 2) providing accuracy criteria for all approvals (such as AC 90-54A), 3) utilization of bias charts and limitations thereof, and, 4) provide all regions with the accuracy data obtained by NAFEC and any other government-sponsored tests.



LORAN-C COVERAGE
Gulf of Mexico
1800ft. Accuracy Contour (2 Sigma
Master: Malone, Fla.

OFFSHORE NAVIGATION, INC.
Drawing No. 711-GOM-MRJ Dec 1, 1978

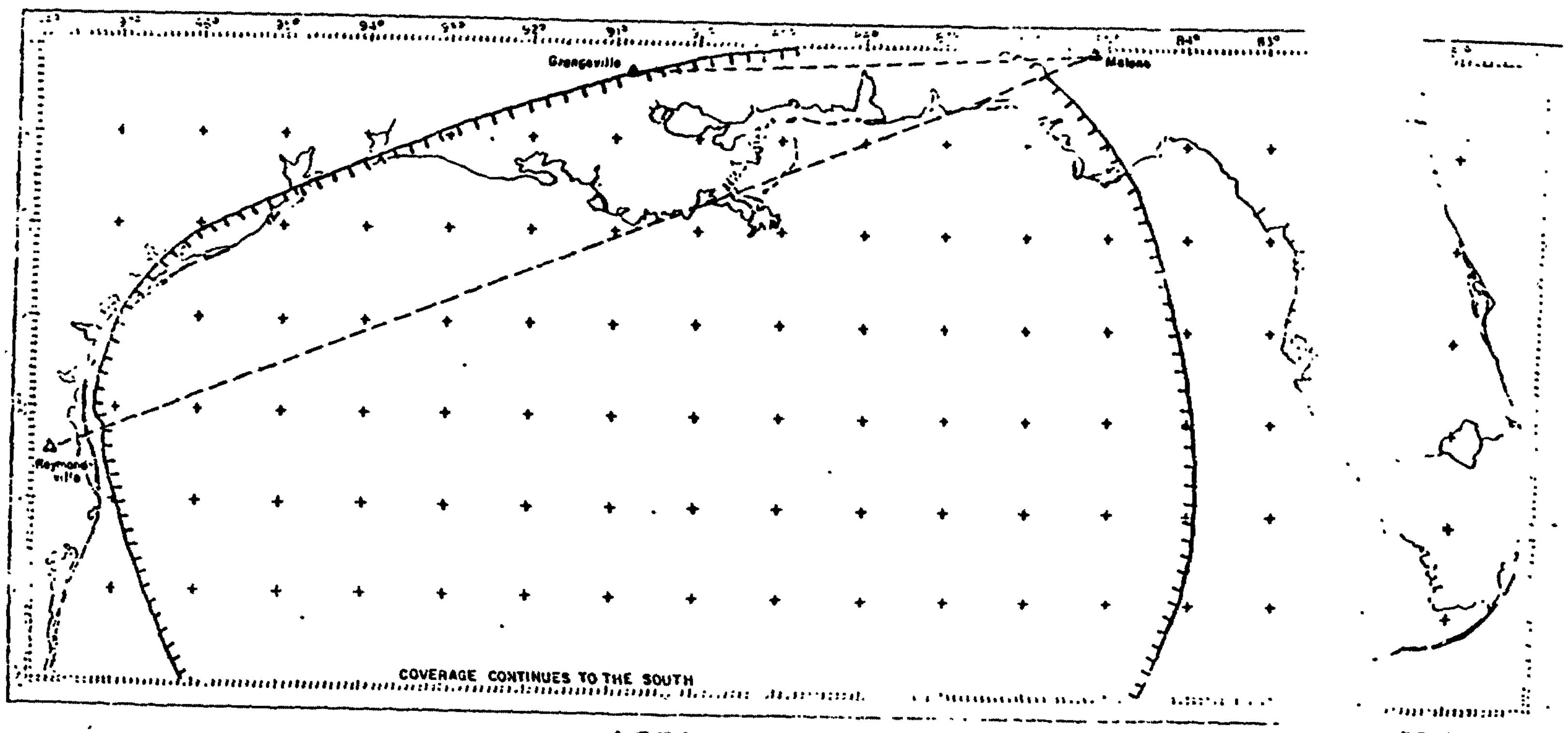
FIG 1



LORAN-C COVERAGE
Gulf of Mexico
1800ft. Accuracy Contour (2 Sigma)
Master: Malone, Fla

OFFSHORE NAVIGATION, INC.

Drawing No. [illegible] Dec 1, 1978



LORAN-C COVERAGE
Gulf of Mexico
1800ft. Accuracy Contour (2 Sigma

OFFSHORE NAVIGATION, INC.
Drawing No. 711-GOM-... 1, 1978
FIG 3

AGENDA ITEM 20.5
RNAV vs. OMEGA APPROVALS

PROBLEM:

Differences in FAA criteria concerning approval of RNAV and Omega systems (reference item from AEA-252).

STATUS:

ACTION:

DISCUSSION: (Ref. Agenda Item 4.1)

The exact problem definition by AEA-252 was not complete, but did initiate a general discussion, which was directed to the fact, that AC 90-45A and AC 20-101A are the applicable guidance documents for RNAV and Omega approvals. The airworthiness rules were not thought to be in question.

CONCLUSION:

No further action.

AEO-252

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

EASTERN REGION
FEDERAL BUILDING
JOHN F. KENNEDY INTERNATIONAL AIRPORT
JAMAICA, NEW YORK 11430

DATE: JUN 25 1979

IN REPLY REFER TO: AEA-252

SUBJECT: 1979 Systems Workshop

FROM: Chief, Flight Standards Division, AEA-200

TO: AFS-800

The Eastern Region's participant for the tentatively scheduled Western Region Engineering and Manufacturing Systems Workshop in October 1979 will be Mr. Ken Higbee.

At this time we wish to submit the following agenda items for discussion at the Systems Workshop:

See Agenda Item 25

1. Differences in FAA criteria concerning approval of RNAV and Omega systems.

2. Inconsistencies in approving major alterations of avionic equipment in aircraft - STC or 337. Also, flight manual supplemental technical material approval.

Brian J. Vincent

BRIAN J. VINCENT

AGENDA ITEM 20.6
MANUFACTURER'S RESPONSIBILITIES

PROBLEM:

Introduction of new products, kits, etc., by manufacturer whereby prior approvals are not indicated (reference enclosed item from AGL-255).

STATUS:

ACTION:

DISCUSSION:

AWS-343 provided a general overview of the subject agenda item. It was suggested that appropriate guidance is necessary, and will be included in AC 20-62C for Avionic Kit Installations.

AWS-130 provided information relative to a policy letter on Heathkit "Strobe Lights".

CONCLUSION.

AWS-343 will review verbage in AC 20-62C for current applicability for avionic kits by 5/80.

AGL-255

AGENDA ITEMS:	Systems Workshop October 1979/Orange County, California
SUBMITTED BY:	AGL-GADO-5, Cincinnati, Ohio
SUBJECT:	Manufacturer's Responsibilities
BACKGROUND:	A manufacturer recently introduced a computer fuel system and promoted its sales by advertising in aviation publications. The sales were also pushed by visits to installing facilities by part suppliers. There was no indication by the manufacturer of any prior approval obtained or required for installing his product. The product's installation instructions also did not relate to any installation approval. Similar situations also exist with other add-on avionic equipment, i.e, VOR/LOC indicators, ranger extenders, etc.
RECOMMENDATION:	When it becomes known to the FAA that a manufacturer is going to introduce a new product for installation in an aircraft, he should be informed of the requirements for performing aircraft alterations.

AC NO: 20-62C

DATE: 8/10/76

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: ELIGIBILITY, QUALITY, AND IDENTIFICATION OF APPROVED AERONAUTICAL REPLACEMENT PARTS

1. PURPOSE. This circular provides information relative to the determination of the eligibility of aeronautical parts and materials for installation on certificated aircraft.

2. CANCELLATION. Advisory Circular 20-62B dated 9/13/74, is cancelled.

3. BACKGROUND. An increasing amount of replacement parts (including standard parts), materials, appliances, and instruments are offered for sale as being of aircraft quality when actually the quality and origin of these units are not known. Users of such units are usually not aware of the potential hazards involved with replacement parts that are not eligible for use on certificated aircraft. Frequently such units are deceptively advertised or presented as "unused," "like new," or "remanufactured." This implies that the quality of such units is equal to an original or appropriately repaired or overhauled unit.

   The performance rules for replacement of parts and materials used in the maintenance and alteration of U.S. certificated aircraft are specified in Federal Aviation Regulations (FAR) 43.13 and FAR 145.57. The responsibility for the continued airworthiness of the aircraft, which includes the replacement of parts, is the responsibility of the owner/operator as outlined in FAR 91.163, FAR 121.363, FAR 123.45, FAR 127.131 and FAR 135.143(a).

4. IDENTIFICATION OF APPROVED PARTS. Approved serviceable replacement parts are identified as follows:

   a. By an FAA Form 8130-3 (Formerly FAA Form 186), Airworthiness Approval Tag. An Airworthiness Approval Tag identifies a part or group of parts that have been approved by authorized FAA representatives.

Initiated by: AFS-804/830

b. By an FAA Technical Standard Order (TSO) number and identification mark that indicates the part or appliance has been manufactured under the requirements of FAR 37.

c. By an FAA/PMA symbol, together with the manufacturer's name, trademark or symbol, part number, and the make and model of the type certificated product on which the part is eligible for installation, stamped on the part. An FAA Parts Manufacturer Approval (FAA/PMA) is issued under FAR 21.305. The make and model information may be on a tag attached to the part.

d. By shipping ticket, invoice, or other document which provides evidence that the part was produced by a manufacturer holding an FAA Approved Production Inspection System issued under FAR 21, Subpart F, or by a manufacturer holding an FAA Production Certificate issued under FAR 21, Subpart G.

e. By a certificate of airworthiness for export issued by a foreign government under the provisions of FAR 21, Subpart N.

5. IDENTIFIED UNSERVICEABLE PARTS, APPLIANCES, AND COMPONENTS. Unserviceable parts, appliances, and components that are identified as outlined in paragraph 4, should be tested, examined, or operated to determine that the articles used meet the requirements of FAR 43.13.

6. UNIDENTIFIED SERVICEABLE OR UNSERVICEABLE PARTS, APPLIANCES AND COMPONENTS. A serviceable or unserviceable unidentified part would have to be reidentified by the manufacturer or a person possessing the required data to certify that the part meets the standards to which it was manufactured as contained in FAR 21.305. A common source of unidentifiable serviceable or unserviceable parts, appliances, and components is outlined in paragraph 7.

7. SURPLUS. Many materials, parts, appliances, and components that have been released as surplus by the military service or by manufacturers may originate from obsolete or overstocked items. Parts obtained from surplus sources may be used, provided it is established that they meet the standards to which they were manufactured, interchangeability with the original part can be established, and they are in compliance with all applicable airworthiness directives. Such items, although advertised as "remanufactured," "high quality," "like new," "unused," or "looks good," should be carefully evaluated before they are purchased. The storage time, storage conditions, or shelf life of surplus parts and materials are not usually known. Example of items that may be available from surplus sources are:

a. Antifriction bearings. Antifriction bearings that have been in storage for a long period, even though encased in protective coating or within a component, are subject to deteriorating effects of time

and the elements. Such items should be completely inspected and lubricated before placing them in service.

b. Aircraft fabric. Fabric and prefabricated covers should be used only if identifiable as meeting aircraft standards. All fabric should be examined for freedom from deterioration due to age, climatic conditions, and contamination.

c. Dope and paint. Dope and paint advertised as aircraft quality may have deteriorated due to age or climatic conditions while in storage and should be tested before use.

d. Avionic parts. Small avionic replacement parts, (e.g., resistors, capacitors, diodes, transistors, etc.), should be the same as or equivalent to the parts identified in the manufacturer's manual and should be tested for performance.

e. Aircraft instruments. Although advertised as "high quality," "unused," "like new," "looks good," or "remanufactured," aircraft instruments should not be put in service unless they have been inspected, tested and overhauled as necessary by an appropriately rated, certificated instrument repair station. Instruments are highly susceptible to hidden damage caused by rough handling and improper storage conditions.

f. Pumps, valves, and actuators. The internal seals are subject to deterioration from long-term storage and are susceptible to early failure in service.

g. Connectors and fittings. The cones, facings and threads have been found damaged due to mishandling. Generally there is no accurate visual means of identifying the specification revision status of a connector or fitting except by assistance from the original manufacturer. Stocking practices should consider specification revision status.

8. ELECTRICAL AND ELECTRONIC KITS. Several kits which are being offered for sale to be assembled by the purchaser and intended to be installed on a standard certificated aircraft may not be eligible for installation. During and after assembly, these kits should receive conformity inspections by properly certificated or authorized persons to assure they meet all applicable airworthiness requirements for use on aircraft. The installation of these approved units should be accomplished under the supervision of a properly certificated airman or agency. When the installation is a major alteration, proper forms should be completed, and a properly certificated person should make the required entries to approve the aircraft airworthy for return to service.

9. UNACCEPTABLE PARTS, APPLIANCES AND COMPONENTS. A common source of unacceptable parts, appliances, and components is outlined in paragraph 10.

10. SALVAGE. Salvaged parts, appliances, or components which have come from aircraft that have been involved in accidents, and rejected parts sold by the manufacturer as scrap metal, are available to industry as replacements. Such items may have been subjected to forces or environments which would render them permanently unairworthy. For example:

a. Parts that have been exposed to heat or fire can be seriously affected and are likely to be unserviceable.

b. Foreign or corrosive liquids can also take their toll of aircraft parts. Parts, appliances, and components from aircraft that have been submerged in salt water have been offered for sale as serviceable replacement parts.

11. KNOW YOUR SUPPLIER. It has come to our attention that many reproduced parts and components, particularly instruments which have been manufactured by persons other than the original manufacturer, are available for purchase and installation on U.S. certificated aircraft. Often, an original part is used as a sample to produce duplicates. The reproduced parts appear to be as good as the original part; however, there are many unknown factors to be considered that may not be readily apparent to the purchaser; i.e., heat treating, plating, inspections, tests and calibrations. All too often the faulty part is not discovered until a malfunction or an accident occurs.

In addition to reproduced parts, used or repaired parts are offered for sale as "like new," "near new" and "remanufactured." When such terms are employed, or whenever a part is not identified as an approved part, the purchaser should have inspections or tests accomplished to determine that the part is airworthy for use on an aircraft in accordance with applicable airworthiness requirements for that aircraft.

12. SUMMARY. In accordance with Federal Aviation Regulations, certification of materials, parts, and appliances for return to service, for use on aircraft, is the responsibility of the person or agency who signs the approval. The owner/operator, as denoted in paragraph 3 of this advisory circular, is responsible for the continued airworthiness of the aircraft. To assure continued safety in aircraft operation, it is essential that great care be used when inspecting, testing, and determining the acceptability of all parts and materials. Particular caution should be exercised when the identity of materials, parts, and appliances cannot be established or when their origin is in doubt.

J. A. Ferrarese

J. A. FERRARESE, Acting Director
Flight Standards Service

AGENDA ITEM 20.7
STANDARDIZED DISPLAY OF INS INFORMATION

PROBLEM:

Lack of definitive policy for standard INS Display requirements (Reference enclosed item from ANW-213).

STATUS.

ACTION.

DISCUSSION.

ANW-213 conducted a detailed discussion on the enclosed item/recommendation. It was suggested, that based on the workshop discussion and further ANW investigations, rulemaking be developed. Past policy letter was discussed.

CONCLUSION:

ANW-213 to investigate and recommend rulemaking (if appropriate) by 1/80.

ANM-213

Subject: Standardized display of INS information

Background:

Inertial navigation systems (INS) are being installed as retrofit equipment on many airplanes which were not originally equipped with long range navigation equipment. Many older airplanes have horizontal situation indicators (HSI) with only two synchros and cannot display all the information which is available from the INS. Some installations of INS have been made in which no heading information is displayed on the HSI when it is driven from the INS (see attached letter).

Discussion:

Airplanes equipped with INS which display data on the HSI must provide the following:

1. A display of magnetic heading and radio information on the HSI.

2. A display of true heading or grid heading (currently available only on some LTN-51 systems).

3. An annunciation of the type of information being displayed on the HSI (the selector switch position is not sufficient).

In addition, actual track, desired track, drift angle, cross track error, and other INS information may also be displayed on the HSI if the information REQUIRED BY 1, 2. AND 3 ABOVE IS ALSO DISPLAYED.

Recommendation:

Implement the policy described above and in the AFS-130 letter dated February 13, 1979.

JAN 1975

ANM-213

Display requirements for airpl. equipped with inertial navigation systems 213

Chief, Flight Standards Division, ANM-200

Director, Flight Standards Service, AFS-1

216

A number of Boeing Model 707 airplanes equipped with inertial navigation systems (INS) have been delivered with horizontal situation indicators (HSI) which do not display heading when the HSI selector switch is in the INS position. When the HSI displays INS information, the HSI compass card is driven to display 0° (North) under the lubber line, regardless 253
of the direction of flight, when the airplane is flying on the desired INS track. The compass card will deflect left or right depending on the track angle error computed by the INS. The course needle must be manually set to 0° by the pilots and INS cross track error is displayed on the HSI deviation indicator. We understand that this design was originally developed by Pan American Air Lines under their DAS authority 210A
in the Southern Region as part of the original INS demonstration program. EA-ACDO-31 has informed us that this configuration was never approved for operation and that Pan American Model 707 airplanes do not display INS information on the HSI.

Recently, Boeing requested certification for a Model 727 airplane with 210
this type of presentation based on similarity to the Model 707 design. All previous Model 727 airplanes have displayed true heading or true track on the HSI when displaying INS information. We were unable to determine the reasoning by which this design could be shown to meet CAR 4b.611(b)(4), since the HSI, which is located adjacent to and directly below the attitude indicator, does not display the direction of flight.

A review of our files from 1969 reveals that the original airplane with this design (Pan American 707) was found to be unsatisfactory because of this type of display. The airplane was delivered with the HSI display of INS information rendered inoperative. However, later airplanes were modified to activate this display with the addition of an annunciator which indicates to the pilot that INS information is displayed.

The Boeing Company has taken the position that installations of this type meet the requirements of CAR 4b.611(b)(4) (or FAR 25.1321(b)(4)) because:

a. The HSI is capable of displaying magnetic heading with the HSI selector switch in the RADIO position and the noted regulations do not require that direction of flight information be displayed continuously, and

b. These airplanes have a radio magnetic indicator (RMI) located adjacent to the HSI which continuously displays magnetic heading regardless of the HSI selector switch position.

c. Other airplanes (not identified) have been certificated with this design.

Flight crews have become accustomed to HSI displays which are oriented to magnetic heading in the RADIO mode and to true heading (or track) in the INS mode. They should not be burdened with nonstandard configurations, especially within mixed fleets or where the possibility of equipment interchange exists. In addition, INS is now being used for navigation on direct routes within the US National Airspace System, and not just for long range over water navigation.

We believe that all future installations of inertial navigation systems which interface with the horizontal situation indicator should provide magnetic heading information when referenced to the conventional compass system and VHF navigation radios and true heading when referenced to inertial navigation systems. True track may be displayed, if heading information is also available on the same instrument. We request your concurrence with this position. We have informed Boeing that we will not certificate any more of their airplanes with this type of installation until this problem is resolved. If you do not concur, please describe what information must be displayed and the location of the required displays which are necessary to comply with CAR 4b.611(b)(4) and FAR 25.1321(b)(4).

Original signed by:
RONALD E. [illegible]

H. A. PARKER

AWM-213:JTreacy:bp:12/28/78
RETYPED:bp:1/4/79
File:

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20591

DATE: [illegible] 1978

IN REPLY REFER TO: AFS-130

SUBJECT: Direction of Flight Display Requirements (CAR 4b.611(b)(4) and FAR 25.1321(b)(4) for Airplanes Equipped with Inertial Navigation Systems; ANW-200 (ANW-210/213) ltrs dtd 12/8/78 and 1/5/79

FROM: Chief, Engineering and Manufacturing Division, AFS-100

TO: ANW-200
Attn: ANW-213

The subject letters stated that the Boeing Commercial Airplane Company has requested certification for a Model 727 airplane equipped with:

1. An inertial navigation system (INS).
2. Horizontal situation indicators (HSI) which:
   (a) Do not display direction of flight when the HSI selector switch is in the INS position, and
   (b) Display magnetic heading when the HSI selector switch is in the RADIO position.
3. Radio magnetic indicators located adjacent to the HSI.

The question is whether the subject regulations require that the direction of flight information be displayed continuously by the heading instrument located below the attitude instrument in the basic T configuration.

CAR 4b.611(b)(4) and FAR 25.1321(b)(4) should be administered as follows:

When an INS is installed and interfaced with an HSI, the HSI must display:

1. Magnetic heading information when selected to the conventional compass system and VHF navigation radio, and
2. True heading or grid heading when selected to INS, and
3. Mode of operation.

However, track angle error may also be displayed on the HSI if the heading or track information as described above is available on the HSI compass card. If track is used on the card, heading information must also be available on the HSI. Aircraft now in-service approved with track angle error without heading information need not be changed provided appropriate pilot annunciation is provided as described above.

We have coordinated this letter with the Air Carrier Division, AFS-200.

James O. Robinson
JAMES O. ROBINSON

ROUTING: 210 ... Reply by ... DATE

File 8109

21.1 OXYGEN

AGENDA ITEM 21.1
PASSENGER OXYGEN REQUIREMENTS
IN FAR § 121

PROBLEM:

Clarify FAR § 121 passenger oxygen requirements (reference enclosed item from ANW-213).

STATUS.

ACTION:

DISCUSSION.

ANW-213 conducted a general discussion of the enclosed item. It was suggested that ANW-213 investigate the preamble and determine any rulemaking action.

CONCLUSION:

ANW-213 to review the preamble and recommend rulemaking (if appropriate) by 2/80.

ANM-213

A. PROBLEM

The passenger oxygen requirements in FAR 121 are presented in several different paragraphs and involve overlapping altitudes, conditions and durations. This situation is confusing and should be clarified.

B. BACKGROUND

The current FAR 121.329(c) addresses cabin pressure altitudes and requires supplemental oxygen (1) for 10% of the passengers if cabin altitude exceeds 10,000 feet for longer than 30 minutes, (2) for 30% of the passengers if cabin altitude exceeds 14,000 feet for any time period, (3) and for all the passengers if cabin altitude exceeds 15,000 feet.

FAR 121.333(e), on the other hand, addresses airplane flight altitude, and requires (1) a 30 minute supply of oxygen for 10% of the passengers if the airplane can descend from 25,000 feet to 14,000 feet in four minutes, and (2) requires sufficient oxygen for 10% of the passengers for the duration of flight if the initial altitude exceeds 25,000 feet or if the four minute descent cannot be made. It is implied, but not stated, that all the passengers will have oxygen available if it is required by flight circumstances or physiological reasons.

C. AVIALABLE OPTIONS FOR A SOLUTION

1. No changes to the wording of FAR 121.329 or 121.333 because they are clear and concise.

2. Change FARs 121.329 and 121.333 to clearly define the passenger oxygen requirements with respect to the following parameters:

   Airplane Altitude
   Cabin Altitude
   Duration at Various Altitudes
   Percent of Passengers to be Supplied Oxygen

D. ANALYSIS OF OPTIONS

Option C1

There is some confusion possible in the interpretation of these two rules. At an airplane and cabin altitude of 13,000 feet, for example, FAR 121.329 requires oxygen for 10% of the passengers after 30 minutes; FAR 121.333 requires oxygen for the first 30 minutes. Because of this confusion, the rules should be clarified and therefore this option should be rejected.

Option C2

For the reasons stated above, the two rules should be clarified and possibly consolidated to facilitate understanding of the oxygen requirements.

E. RECOMMENDATION

It is recommended that Option C2 be accepted.

22.0 PNEUMATIC

(No Agenda Item Submit   For Future Reference Only)

23.0 VACUUM

(No Agend- Item Submitted. For Future Reference Only)

24.0 WATER/WASTE

(No Agenda Item Submitted. For Future Reference Only)

25.0 AIRBORNE AUXILIARY POWER

(No Agenda Item Submitted. For Future Reference Only)

26.0 ENGINE FUEL CONTROL

AGENDA ITEM 26.1
ELECTRONIC FUEL FLOW
SYSTEM

PROBLEM.

Guidance material considerations for new electronic fuel flow systems (reference enclosed item from AGL-255).

STATUS.

ACTION.

DISCUSSION: (Reference Agenda Item 4.4)

AGL-255 reviewed the enclosed item. It was determined that AWS-140 had developed policy related to subject problem.

CONCLUSION:

AWS-130 to coordinate with AWS-140 policy by 1/80.

AGL-255

AGENDA ITEMS: Flight Test/Systems Workshop
October 1979 - Los Angeles

SUBMITTED BY: AGL-GADO-3, West Chicago, Illinois

SUBJECT: New Electronic Fuel Flow System

BACKGROUND: Previous fuel flow systems have been of the "wet tubing" type which came with the type certificate approval for the aircraft.

DISCUSSION: New electronic type fuel flow systems utilizing transducers are now on the market.

Examples: (1) Symbolic Displays, Inc., CFS/1000/2000 Computerized Fuel Systems

(2) Aerosonics Fuel Management Computer

(3) Aveions AF1, TT1, or TZ1 systems

(4) Crystal Instruments Systems.

These are offered, for the most part, as add-on systems but in some cases, the original system in the aircraft has been removed and replaced with the electronic system. In all cases, engineering must be consulted for whatever approval basis is involved - STC or FAA Form 337. More specific information and guidelines should be set forth with regards to what systems utilize TSO's on some of their components, indicators, transducers, etc. What relationship to FAR 23.1305(g), which requires a fuel pressure indicator for pump fed engines, is involved, etc.,?

RECOMMENDATION: An Advisory Circular covering these installations should be formulated.

27.0 IGNITION

(No Agenda Item Submitted. For Future Reference Only)

28.0 ENGINE CONTROL

(No Agenda Item Submitted. For Future Reference Only)

29.0 AIRCRAFT WIRING

AGENDA ITEM 29.1
WIRE TERMINATIONS

PROBLEM:

Lack of agency requirements/guidance material for aircraft wire terminations (reference enclosed item form AGL-213).

STATUS:

ACTION:

DISCUSSION:

A general discussion by AGL-213, based on their experience relative to automotive or appliance type quick disconnect wire terminations. AC 43.13-1A recommends screwtype terminals. Suggest that FAA adopt a policy of "non-use" on critical circuits.

CONCLUSION:

AGL-213 to provide a draft policy letter on wire terminations by 12/79.

AWS-343 to review AC 43.13-1A for applicability by 12/79.

SUBJECT: Wire terminations in aircraft

BACKGROUND: The Agency does not have specific requirements for wire terminations nor does it have adequate guidance material in the form of an Advisory Circular. AC 43.13-1 discusses the strength of the wire to terminal junction, but does not make any statement relative to strength of terminal-to component connection.

DISCUSSION: The FAA has a serious lack of regulatory material and advisory circular material relative to aircraft wire and its termination in aircraft. The regulations relative to this subject are general in nature and the advisory material, although specific relative to certain points, is incomplete and has resulted in a condition that could result in problems.

At least one airplane has been approved with "quick-connect" terminations for a majority of its wire terminations (they "quick-disconnect" with the same effort it takes to connect them). This was without FAA engineers being aware this type termination was being used. The aircraft has been in service for many years without any reported adverse experience. The nature of any such service difficulties are such that the time required to report them far exceeds the time required to make a repair. We also know that aircraft having "quick-connect" wire terminations are a very small portion of the civil aircraft in service. We, therefore, would not expect any service difficulty history.

The basic criteria for wire terminations has been that the termination of the wire transmits the strength of the wire through the termination to the component or terminal the wire is terminated on, and the resistance of the termination be negligible relative to the wire resistance. The problem exists that this has never been stated as a regulation and has not been set forth clearly in any advisory material. Report 50 and AC 43.13-1A speak to this problem, but not with the thoroughness needed.

The integrity of aircraft wiring carrying energy capable of causing an electrical spark is essential to safety. FARs 23, 25, 27, and 29 should require a minimum tensile strength in aircraft wire equivalent to 22 gauge copper wire, and the termination of all aircraft wire transmits that tensile strength through its termination to the component it is terminated on. The wire should be required to have the flexibility of 19 strand wire of the appropriate gauge.

AVAILABLE OPTIONS:

1. Amend FARs 23, 25, 27, and 29 to require a minimum tensile strength in aircraft wire equivalent to 22 gauge copper wire, and the termination of all aircraft wire transmit that tensile strength through its termination to the component it is terminated on. The wire should be required to have the flexibility of 19 strand wire of the appropriate gauge.

2. Issue a New Advisory Circular on aircraft wire and its termination.

3. Revise AC 43.13-1A to be current relative to available wire and include the necessary information on wire termination.

ANALYSIS OF OPTIONS:

1. The FARs do not speak specifically to aircraft wire, but instead cover it by references to system safety. This causes variations from region to region and places a burden on the Regions in their obtaining compliance with the intent of the regulations. Such requirements would prevent further occurrences like we now have relative to quick-connect terminals.

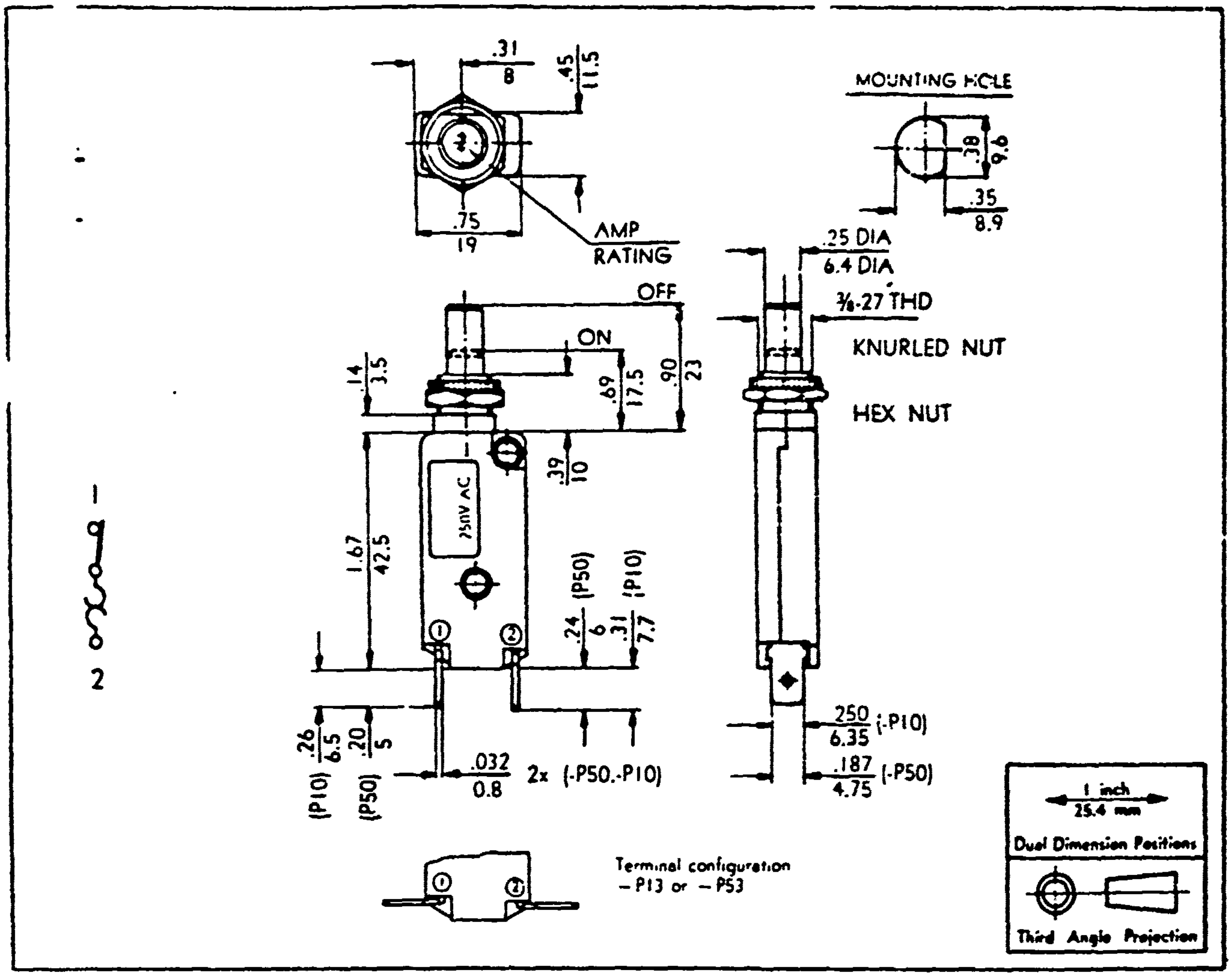
2. Aircraft wire is a subject of such importance in aircraft safety that it should have a document dealing solely with its problems. Such a document could be more easily kept current than current guidance material that does not pertain to aircraft design.

3. AC 43.13-1 is a maintenance and inspection document and is not part of the certification basis for aircraft. Its revision is definitely needed, but it would still fall short of an effective solution to the problem.

RECOMMENDATIONS:

Adopt Option 1 and also Option 2 to assist in implementing Option 1.

Option 3 should be implemented because AC 43.13-1 is the document referred to by mechanics in making aircraft alterations.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6
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7.7
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2
.26
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5
(P10)
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0.8
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.250
6.35
(-P10)
.187
4.75
(-P50)
1 inch
25.4 mm
Dual Dimension Positions
Third Angle Projection
Terminal configuration
– P13 or – P53

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

GREAT LAKES REGION
2300 EAST DEVON AVENUE
DES PLAINES, ILLINOIS 60018

DATE

DRAFT

IN REPLY REFER TO

SUBJECT Aircraft wire termination; Systems and Equipment Agenda Item 29.1

FROM

TO

Aircraft wire termination has been discussed between regions and Washington the past year and was a significant discussion item at the October 1979, Systems and Equipment Workshop.

All FAA guidance material relative to the subject has been developed on the premise that aircraft wire would be terminated on connectors with integral cable clamps or with terminals as depicted in Figure 11.12 of AC 43.13-1A. As such terminations would clearly transmit the strength of the wire thru the terminating point as if the wire was unbroken at that point, no further guidance was deemed necessary. As a result the guidance material focused on the wire-to-terminal portion of the junction and emphasized that the strength of the wire must be transmitted thru that junction. This was set forth in Report 50, Design Guide for Personal Aircraft Electric Systems, August 21, 1952, and subsequently carried over into AC 43.13-1A, Paragraph 450.

It has now become apparent that failure to clearly set forth guidance material relative to the type of terminals that are FAA approved has resulted in terminals being used in civil aircraft that do not transmit the strength of the wire through the junction.

To assure compliance with FAR 21.21 and Subpart F of the applicable airworthiness rules, the following policy is applicable to all wire terminations in civil aircraft.

The strength of all aircraft wire must be transmitted through whatever means is used for its termination to the component on which the wire is terminated, or a rational analysis must be prepared that assures no degradation of safety will occur in any anticipated environment should any individual wire become disconnected. This must include the loss of function, possible shorts to ground or other adjacent circuits.

All aircraft that do not currently meet this criteria should be re-examined in accordance with Section 609 a. of the FA Act and action taken to correct the deficiency.

SUBJECT: Aircraft Wire

BACKGROUND: Aircraft Wire has been a topic of discussion between the FAA and Industry recently. The basic problem is the FAA does not have a document that sets forth what wire is acceptable in aircraft. Attachment 1 reflects the confusion that exists relative to this subject.

DISCUSSION: The answer to Industry questions relative to what is acceptable aircraft wire has varied between regions. Obviously some errors have been made. The FAA needs to clean its house relative to this subject so future mistakes can be eliminated. At least two regions have issued letters on the subject and the positions taken by the two regions are not the same.

AVAILABLE OPTIONS:

1. Issue a New Advisory Circular on aircraft wire and its termination.

2. Revise AC 43.13-1A to be current relative to available wire and include the necessary information on wire termination.

3. Do nothing.

ANALYSIS OF OPTIONS:

1. The FARs do not speak specifically to aircraft wire, but instead cover it by references to system safety. AC 43.13-1A is not a complete treatment of the subject and its stated intent is maintenance and inspection - not manufacture and alteration. A new advisory circular would eliminate differences between the regions and eliminate much of the confusion that exists relative to maintenance and alteration that now exists.

2. Revision of AC 43.13-1A is definitely needed, but a very poor substitute for option 1. Referring a manufacturer to AC 43.13-1A leads a manufacturer to assumptions that he can use it to build his aircraft regardless of his certification basis. We still need to revise AC 43.13-1A.

3. Doing nothing just continues our problem.

RECOMMENDATION:

Adopt Options 1 and 2.

AGENDA ITEM 29.2
AIRCRAFT WIRE

PROBLEM:

Lack of acceptable standard and guidance material for aircraft wire (Reference enclosed items from AGL-213 and AGL-255).

STATUS:

ACTION:

DISCUSSION: (Reference Agenda Item 3.8)

During the aircraft wire standards discussion, it was recommended that AC 43.13-1A and 2A be updated to describe acceptable standards for wire. The AEA convention conducted 3 workshops on wire. SAE-A2H committee is currently drafting a general wire specification, and a draft was provided at the workshop. It was also noted, that there are no marking requirements; but concern was reflected that consideration should be given. Attendees indicated that FAR 43.13 is adequate and no other rule is necessary.

CONCLUSION:

AWS-343 will attempt to update AC 43.13-1A for wire marking, actual wiring diagrams,and the SAE wire standards, by 3/80.

AWS-130 proposes to investigate the use of "Typical" wiring diagrams with the manufacturer's, through the regions.

AGL-255

<u>OFFICE</u>: AGL-GADO-20, Ypsilanti, Michigan

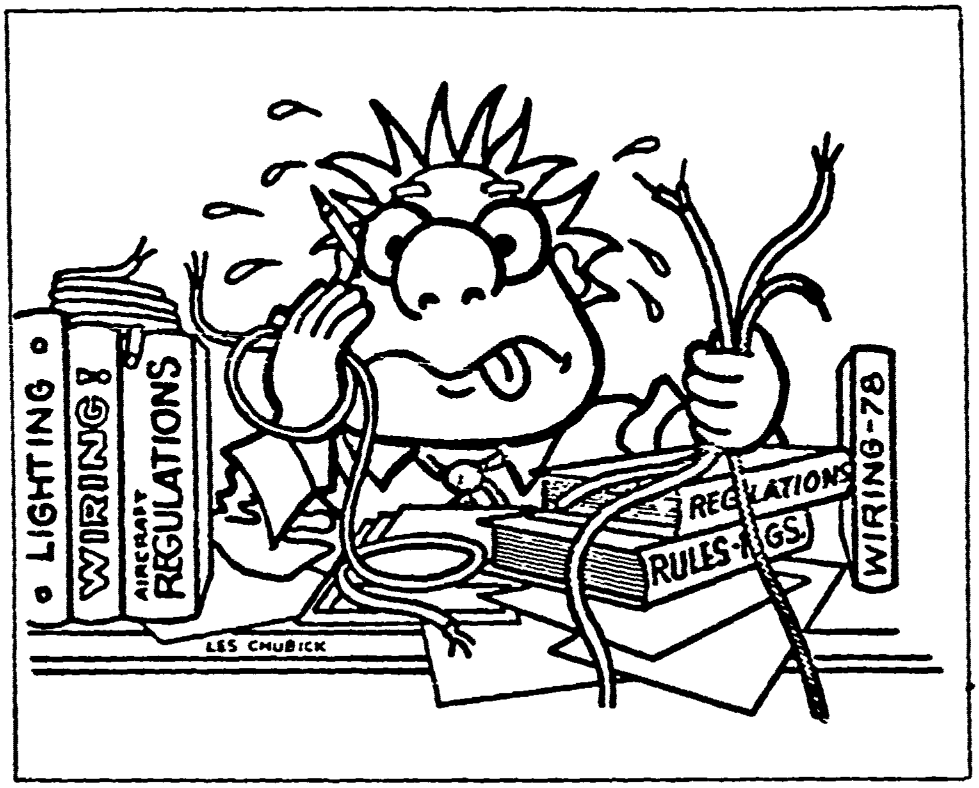
<u>SUBJECT</u>: Lack of current Aircraft Wiring Diagram

<u>BACKGROUND</u>: We have older aircraft around such as the B-18, which has miles of old wiring in them which are not being used as new systems are being put in. Wiring is not marked/identified and owner/operator are not being given wiring diagrams for the work which was done. Also, there are no FAA requirements for repair stations to mark identify where or what wire MIL Spec to use.

<u>RECOMMENDATION</u>: Require persons making installations identify wire by marking the wire with approved methods and supply the aircraft owner with a wiring diagram of the installation.

ARE YOU USING THE RIGHT WIRE?

AGL-213-5 Attachment 1



There is much confusion about the proper types of wire that can be used on various general aviation aircraft. This short article does not contain the answers to this confusion, but is intended to provide you with a little data that you can start with to find the answers.

First, I refer your to FAR 23, paragraph 23. 1365 (b), which states "Each cable and Associated equipment that would overheat in the event of circuit overload or fault, must be at least flame resistant and may not emit dangerous quantities of toxic fumes."

Second, I refer you to FAR 25, paragraph 25.1359 (d), paragraph 25.1357 (d), and Part 25, appendix F, paragraph (g), which specifies in detail the flammability tests required for aircraft wire in a part 25 aircraft.

Third, I refer you to Advisory Circular AC43.13-1A, figure 11.7A, which lists various wire used in aircraft installations. (Note that MIL-W-5086, MIL-W-22759, MIL-W-16878, Type EE, and MIL-W-81044A, are probably the wires that are most accessible for your shop to purchase.)

Fourth, I refer you to AC43.13-1A, paragraph 443, which discusses Aircraft Electrical Wire.

At this point everything should still be reasonably clear. However, please note the following discrepancies:

1) Most MIL-W-16878 wire on the market is Type B or Type D, not Type EE. While 16878 Type B & D are excellent wire, where do we get approval to use them?
2) If you refer back to AC43.13-1A, figure 11.7A, note that in the left hand column labeled "Standard", Mil-W-16878 Type EE is listed as None. (This refers to manufacturing testing standards.)
3) If you can find a copy of MIL-W-5088F dated 30 June 1976, entitled "Military Specification Wiring, Aerospace Vehicle", refer to paragraph 3.6.4 and note that "the finished wire shall be identified by printed marking applied to the outer surface of the wire", and that "The printing shall be green in color in accordance with MIL-STD-104." Therefore, if you are purchasing MIL Spec wire for use in aircraft you should be able to identify it by looking at it.
4) There is a letter from Southwest Region, FAA Engineering, that states, "MIL-W-5086/1,/2, and /4 are not acceptable for those aircraft required to comply with Appendix F of FAR 25, effective after May 1, 1972".

Now after you have performed all these exercises to determine if you are using the right wire, and still don't know, join the crowd.

We still haven't discussed toxic gas standards, non-approved wire, other MIL-Spec Wire, etc.

Don't give up in despair yet! Look at your wire, your aircraft, and jot down your questions. Then come to Phoenix, April 30th for our National AEA Convention. Our wire workshop will have a panel to give you accurate answers to your questions.■

AGL-255

OFFICE: AGL-GADO-20, Ypsilanti, Michigan

SUBJECT: Lack of current Aircraft Wiring Diagram

BACKGROUND: We have older aircraft around such as the B-18, which has miles of old wiring in them which are not being used as new systems are being put in. Wiring is not marked/identified and owner/operator are not being given wiring diagrams for the work which was done. Also, there are no FAA requirements for repair stations to mark identify where or what wire MIL Spec to use.

RECOMMENDATION: Require persons making installations identify wire by marking the wire with approved methods and supply the aircraft owner with a wiring diagram of the installation.

FLIGHT TEST/SYSTEMS COMBINED MEETING

AGENDA ITEM F/S 1
PARALLEL CODIFICATION OF TC RULES

PROBLEM:

Discussion/proposals of parallel codification of type certification rules (Reference enclosed item from ACE-216).

STATUS:

ACTION.

DISCUSSION:

During normal rulemaking actions, commentors should provide justification as why parallel change's are not necessary.

CONCLUSION:

No further action.

ACE-216

FLIGHT TEST/SYSTEMS WORKSHOP - OCT. 1 - 12, 1979

ENGINEERING AND MANUFACTURING DISTRICT OFFICE
PROPOSED AGENDA ITEMS

Priority 3

3. SUBJECT: Parallel ~~codification of type~~ certification rules - (Joint Flight Test/Systems Workshop Discussion)

Background: As a ~~result of recodification~~ of FAR Parts 23, 25, 27 and 29, a subject treated in a numbered section of one rule will be treated in an identically numbered section in another. When rules are revised or amended, there has been consistent effort to revise or amend all rules in parallel. The separate and distinct nature of the Parts has in some cases been overlooked. Formal proposals, and at least one adopted FAR 23 section, appear to have been defined on need under one FAR part and inappropriately paralleled in another.

Discussion: The four type certification FAR's are separate and different rules, intended to provide safety for different kinds of aircraft, to be operated under different guide lines. Justifications provided for rule-making action appear, for the most part, related to needs under one of the four FAR's. A proposal for transport category airplanes, for example, is justified with respect to transport category experience. If careful examination by the Office of Primary Interest (OPI) shows that a proposal should be made applicable to other FAR Parts, this can be done. There appears a tendency to make the rules read alike, however; and there are pressures on the OPI to disprove the need for additional applicability. With minimum Headquarters staffing, there may not be resources for adequate review. An example of inappropriate parallel is seen in § 23.729 and 25.729. A landing gear warning system requirement, based on FAR 25 flap management procedures, was imposed on FAR 23 airplanes. FAR 23/FAR 91 airplanes do not have the same flap management procedures as FAR 25/FAR 121 airplanes. As a result, the warning system required by § 23.729 is perceived as inappropriate, and has been formally charged under § 21.21(b) as being a safety hazard in its own right.

Options Available:

1. Continue the present system, in which all proposals are considered for parallel codification; omitting it where applicability is disproved by the OPI.

2. Consider proposals for adoption only under FAR parts specified by the proponent.

3. Consider proposals for adoption under the FAR parts specified by the proponent. OPI affirmatively recommend parallel codification when needed, providing separate justifications for Notice.

Discussion of Options:

1. Option #1 places the OPI in the untenable position of working against deadlines to disprove the need for applicability beyond that suggested by the proponent. The OPI may not be adequately staffed to do this, and there is a danger of default in the process. - Not recommended.

2. Option #2 would do away with inappropriate parallels, but could delay the adoption of parallel rules which are clearly justified. Although preferable to Option #1, Option #2 is - Not recommended.

3. Option #3 would provide for rule paralleling decisions by the OPI, and would protect against adoption by default. Proponents views could be evaluated on the basis of merit under each FAR, without pressure for "across-the-board" adoption. - Recommended.

Recommendation:

Option #3 - Decisions on parallel adoptions reserved to OPI.

AGENDA ITEM F/S 2
OMEGA or OMEGA/VLF APPROVALS

PROBLEM:

Disagreement between Engineering and Field Personnel on OMEGA/VLF approvals (Reference enclosed item from AEA-216).

STATUS:

ACTION:

DISCUSSION: (Reference Agenda Item 4.1 and 20.3)

Recommendation that coordination between Regional Engineering and Field Personnel (per AI4.1) be conducted. Reference to AI 20.3 "Note" for appropriate guidance.

FAA's practice of referencing the vendor's "manual" in the Airplane Flight Manual was questioned by a region's legal counsel, even though it has been common practice for the past ten years.

CONCLUSION:

AWS-160 to review AFM for referencing manufacturer's manual by 12/79.

All regions requested to identify Omega Approvals to AWS-130 by 12/79.

AWS-130 to collate a listing of Omega Approvals and transmit to all regions by 1/80.

AEA-216

yet/sophus

AEA-216 AGENDA ITEMS

SUBJECT: OMEGA or OMEGA/VLF APPROVALS

BACKGROUND:
There is substantial disagreement between Engineering and Field personnel on whether Omega or Omega/VLF Systems should be approved under STC or Form 337, relative to Airworthiness approval. This is primarily due to the ambiguity of the associated Advisory Circular.

DISCUSSION:
Advisory Circular 120-31A "Operational and Airworthiness Approval of Airborne Omega Radio Navigation System as a means of Updating Self-Contained Navigation System." This circular implies STC approval via a general paragraph which states that the applicant should contact FAA Regional E & M or E & M District Office (Pg. 2, Item 5).

Advisory Circular 20-101 dated October 14, 1977, "Omega and Omega/VLF Navigation System Installation Approval in the Conterminous United States and Alaska." This AC is for enroute navigation and states installation approval through STC or TC.

AC 91-49 "General Aviation Procedures for Flight in North Atlantic Minimum Navigation Performance Specifications Airspace." This circular states approvals via TC, STC, or 337 (Pg. 4, Item 4c(1)).

AC 120-33 "Operational Approval of Airborne Long-Range Navigation System for Flight within the North Atlantic Minimum Navigation Performance Specification Airspace." This circular implies the original approval is by STC (Pg. 5, Item (8)).

AC 120-37 "Operational and Airworthiness Approval of Airborne Omega Radio Navigation System as a Sole Means of Overwater Long Range Navigation." This AC states approval is by STC or TC (pg. 2, Item 4).

AC 90-45A "Approval of Area Navigation Systems for use in the U. S. National Airspace System." This AC provides for approval under STC (Appendix B, Page 1, Par. 1) or Form 337 (Appendix B, Page 2, paragraph 2).

AVAILABLE OPTIONS:
1. Allow Approvals only through STC.
2. Allow Approvals by STC or 337

ANALYSIS OF OPTION

OPTION 1; (STC Approval Only) - has the advantage of using the technical know how of all the engineering sections in arriving at a Type Inspection Authorization that adequately cover the test program. It further assures via the issuance of a TIA, a satisfactory review of the design data by Structures, Systems and Equipment Section.

<u>OPTION 2</u> - This is the procedure now in existence and results in duplication in effort of the field and regional personnel. One of the reasons this occurs is there is always an Airplane Flight Manual involved which must be signed by the region. Our region further has a requirement (Supplement 8310.4a EA FS Sup 1 dated March 1, 1973), that states that if engineering flight tests are involved, an STC is required. In view of this, data must be submitted to the field and they in turn must forward part of it to the region for review prior to signing the Airplane Flight Manual.

It is further believed that since Omega systems are interfacing with autopilots, flight directors and air data computers, their complexity make it imperative that STC procedure be followed.

<u>RECOMMENDATION</u>:
All airworthiness approvals for Omega systems should be by STC.

AGENDA ITEM F/S 3
ATMOSPHERIC ICING

PROBLEM:

Airframe Icing Criteria and Small Airplane Icing approvals (Reference enclosed items from AWE-160 & ACE-216).

STATUS:

ACTION:

DISCUSSION:

AWE requested other regions experience on icing flight testing. Various aircraft tanker techniques were discussed. AWE provided the enclosed briefing paper for discussion.

ACE discussion item(b), EMDO 43 recommended AD action. AFO-512 has conducted a study at the request of AWS-130. The study results indicate a change to FAR 91. AWS-130 indicated, that a NTSB investigation is in progress on Light Aircraft Icing.

CONCLUSION.

AFO-512 to provide study results to AWS-130 by 12/79.

AWE-160, ACE-210, and ASO-210 were to provide icing criteria and experience on CAR 3/Part 23 to AWS-130/160 by 1/80.

AWS-130/160 to transmit criteria to all regions.

AWS-130/160 to provide policy letter on CAR 3 Icing after review of NTSB study.

AWE-160

ATMOSPHERIC ICING

(8) Airframe Icing Criteria - FAR 23

Background: Western Region has had extensive experience with transport icing flight tests, which generally involve a) ice detection, b) engine and airframe characteristics after ice accretion, c) handling qualities with ice shapes, d) effects of ice shapes on performance, and e) proper functioning of anti-ice/de-ice systems and effects of related ice shedding. We have had no experience yet with FAR 23 airplanes, but expect to during the 1979-80 winter. We would be interested in a discussion of requirements and test procedures used by other regions, and would offer our views gained from past transport programs. The amendment 23-14 change to FAR 23.1419 requiring accountability for the icing environment of FAR 25 Appendix C, together with AC 20-73 constitute both the justification for this topic and virtually the only published guidance. Needed is uniform guidance on such questions as acceptable degradation of stability, controllability, trimmability, stall characteristics and stall speeds and approach and landing climb.

ACE-216

(Continued)

(b) Small Airplane Icing Approvals on Non-Hazard Basis

Discussion: Many items of icing equipment have been installed on CAR 3 and FAR 23 aircraft on a non-hazard basis in that the installed equipment does not adversely affect the aircraft. Consequently, in addition to not meeting the certification requirements for icing flight, these aircraft and installed equipment do not meet the requirements of FAR 135.227(b)(1) and are therefore prohibited from operationally flying IFR into known or forecast moderate icing conditions. However, for aircraft not required to comply with the above noted regulation, many people in the field have expressed concern that the pilots mistakenly believe that the airplane he is flying is approved for flight into icing conditions. This is further complicated by the fact that some of these models are now being delivered equipped and approved for flight into known ice while others are not. This creates an environment where a pilot may fly one of the approved aircraft and sometime later have occasion to fly one that has similar equipment but has not been approved. If his observation of these two airplanes showed that the same equipment was installed on both and a placard is not installed he may easily assume that the second airplane is also approved for icing flight. A review of 194 icing related accidents covering a 6-year period indicates that in 97 instances the icing encounter may have been avoided had a placard been installed to alert the pilot.

Options:

1. Do nothing.

2. Revise applicable regulations to require the installation of a placard similar to that required by FAR 23.1559(b).

Recommendation:

Proceed with Recommendation No. 2.

AWE-160

BRIEF

The Amendment 23-14 change to FAR 23.1419, Ice Protection Requires accountability for the icing environment of FAR 25 Appendix C., together with AC 20-73.

Guidance is needed on such questions as acceptable degradation of stability controllability, trimmability, stall characteristics and stall speeds, and approach and landing climb.

FAR 23.1419 reads basically the same as 25.1419., Ice Proection

FAR 25-1419 (b) reads:

The airplane must be shown to safely operate in continuous maximum and intermittent maximum icing conditions determined under Appendix C. Analysis must be performed to establish on the basis of the airplanes operational needs, the adequacy of the ice protection system for the various components of the airplane.

Under FAR 25.1419 it has been the practice to find compliance with the rule when testing with ice shapes on the unprotected areas. Where stall speeds have been affected, AFM recommendations for increased approach speeds have been included in procedures. Approach and landing climb charts have included factors for performance degradation.

The following are the flight tests required for ice shapes:

- o stall characteristics
- o stall speeds
- o controllability and maneuverability
- o static Long stab - appr. and land config
- o Directional control - Heading changes
- o Static lateral, directional stability
  approach and land config.
- o trim 1.4 Vs
- o Hi speed char. pullups, pushovers rolls and turns up to 300 Kts
- o VMCA
- o performance

ATTENDEES

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John Reed	AWS-130
Bob Ford	AWS-160
Nick Dobi	AWS-160
Bob Kennedy	AWS-160
Jack Flavin	AWS-330
Gene Sherman	AWS-343
Bob Ball	AFO-510
Bob Klapprott	EMDO-43
Hal Foland	ICT-EMDO-43
Bob Gambrill	ICT-EMDO-43
Fred Lee	AEA-213
Jim Plackis	AEA-216
Al Vetter	AEA-216
Ken Higbee	AEA-252
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Jay Shapley	ASW-216
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Chuch Smalley	AGL-213
Charles Arnold	AGL-216
Jon Hannan	AGL-216
Walt Glockner	AGL-255
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Ron Varuska	ANE-213
E. Park	ANE-256
ARnie Rassmusen	ANW-213
Jim Treacy	ANW-213
Dean Melton	ANW-216
Dean Kiempel	ANW-216
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Frank McGowan	ASO-216
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REFERENCES

- Report No. AFS-130-78-1, "Report of the Aircraft Systems/Flight Test Workshop", dated November 8-17, 1977, Engineering and Manufacturing Division, Systems and Flight Test Branches, Flight Standards Service, Federal Aviation Administration